



# TEST AREA C-62 FINAL PROGRAMMATIC ENVIRONMENTAL ASSESSMENT



DEPARTMENT OF THE AIR FORCE  
Air Armament Center  
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# EGLIN AIR FORCE BASE FLORIDA

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## TEST AREA C-62

## FINAL PROGRAMMATIC ENVIRONMENTAL ASSESSMENT



**May 2002**

**TEST AREA C-62**

**FINAL PROGRAMMATIC  
ENVIRONMENTAL ASSESSMENT**

**Submitted to:**

**AAC  
46 TW/XPE  
Range Environmental Planning Office  
Eglin Air Force Base, FL 32542-6808**

**RCS 99-149**

**MAY 2002**



Finding of No Significant Impact  
Test Area C-62 Programmatic Environmental Assessment  
For The  
Air Armament Center  
Eglin AFB, FL  
RCS 99-149

The Air Armament Center at Eglin Air Force Base, Florida, proposes to authorize an increased level of military test and training activities on Test Area (TA) C-62. TA C-62 is one of several land test areas in the northeast corner of the Eglin Reservation. During the baseline period (FY95-97), TA C-62 supported approximately 600 missions.

The Proposed Action will allow the Commander, 46<sup>th</sup> Test Wing, to authorize levels of activity at TA C-62 based upon estimates of increased use. Four alternatives were considered:

- Alternative 1 (No Action): Maintain baseline level of activity (FY95-97 Range Utilization Report) without formal authorization;
- Alternative 2: Authorize activity at the baseline level (Alternative 1);
- Alternative 3: Authorize the activities contained in Alternative 2 and include a number of "good management practices"; and
- Alternative 4: Authorize the activities contained in Alternative 3 and provide for an additional 100% increase in all missions except for explosive ordnance disposal operations.

SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

The Programmatic Environmental Assessment concentrates on the subject areas that have the greatest likelihood for potential environmental impacts. In each case, the assessment concluded that selection of the preferred alternative would not result in significant environmental impacts. Some of the areas studied include:

- Noise from detonations of test and training munitions, and
- Hazardous materials from the residue of military munitions.

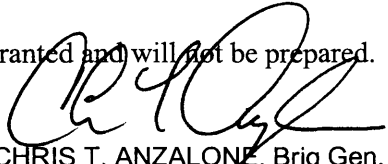
BASIS FOR FINDING OF NO SIGNIFICANT IMPACT:

The Test Area C-62 Programmatic Environmental Assessment was prepared in accordance with the requirements of the National Environmental Policy Act, the Council on Environmental Quality Regulations and 32 CFR 989 (Air Force Instruction 32-7061, "The Environmental Impact Analysis Process"). Selection of Alternative 4, the preferred alternative, for Test Area C-62 will not have significant impact upon the human or natural environment.

Therefore, an Environmental Impact Statement is not warranted and will not be prepared.

DATE

**DEC 23 2003**

  
CHRIS T. ANZALONE, Brig Gen, USAF  
Vice Commander



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## ACRONYMS, ABBREVIATIONS, AND SYMBOLS

<b>AAC</b>	Air Armament Center
<b>AAC/EMH</b>	Air Armament Center/Environmental Management Directorate, Cultural Resources
<b>AAC/EMSN</b>	Air Armament Center/Environmental Management Directorate, Natural Resources
<b>ACE</b>	U.S. Army Corps of Engineers
<b>ADR</b>	Ammunition Disposal Requisition
<b>AFB</b>	Air Force Base
<b>AFDTC</b>	Air Force Development Test Center
<b>AFMC</b>	Air Force Materiel Command
<b>AGL</b>	Above Ground Level
<b>AMRAAM</b>	Advanced Medium Range Air-to-Air Missile
<b>AOC</b>	Area of Concern
<b>BDL</b>	Below Detection Limit
<b>BTEX</b>	Benzene, Toluene, Ethylbenzene, and Xylenes
<b>C</b>	Centigrade
<b>C<sup>2</sup></b>	Command and Control
<b>C<sup>4</sup>ISR</b>	Command, Control, Communications, Computers, Intelligence, and Surveillance/Reconnaissance
<b>CATEX</b>	Categorically Excluded
<b>CEC</b>	Cation Exchange Capacity
<b>CE-EOD</b>	Civil Engineering Explosive Ordnance Disposal
<b>CEQ</b>	Council on Environmental Quality
<b>CO</b>	Carbon Monoxide
<b>CWA</b>	Clean Water Act
<b>DAT</b>	Diaminotoluene
<b>dbh</b>	Diameter at Breast Height
<b>dBp</b>	Unweighted Peak Sound Pressure Level
<b>DNT</b>	Dinitrotoluene
<b>DoD</b>	Department of Defense
<b>DOPAA</b>	Description of Proposed Actions and Alternatives
<b>DPI</b>	Direct Physical Impact
<b>EA</b>	Environmental Assessment
<b>EAR</b>	Effector Analysis Report
<b>EIA</b>	Erosion Impact Area
<b>EIAP</b>	Environmental Impact Analysis Process
<b>EIS</b>	Environmental Impact Statement
<b>EOD</b>	Explosive Ordnance Disposal
<b>F</b>	Fahrenheit
<b>FA</b>	Floridan Aquifer
<b>FDEP</b>	Florida Department of Environmental Protection
<b>FFWCC</b>	Florida Fish and Wildlife Conservation Commission
<b>FNAI</b>	Florida Natural Area Inventories
<b>FONSI</b>	Finding of No Significant Impact
<b>FWRA</b>	Florida Watershed Restoration Act
<b>FY</b>	Fiscal Year
<b>g/cm<sup>3</sup></b>	Grams per Cubic Centimeter
<b>GIS</b>	Geographic Information System
<b>HE</b>	High Explosive
<b>HMX</b>	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
<b>HVAR</b>	High Velocity Air Rockets
<b>IRP</b>	Installation Restoration Program
<b>IS</b>	Intermediate System
<b>kPa</b>	Kilopascals
<b>LAWS</b>	Light Anti-Tank Weapon System
<b>lb</b>	Pound
<b>LFA</b>	Lower Floridan Aquifer

## ACRONYMS, ABBREVIATIONS, AND SYMBOLS CONT'D

<b>m<sup>3</sup></b>	Cubic Meters
<b>MCL</b>	Maximum Concentration Levels
<b>MDL</b>	Method Detection Limit
<b>mg/kg</b>	Milligrams per Kilogram
<b>mg/L</b>	Milligrams per Liter
<b>mg/m<sup>3</sup></b>	Milligrams per Cubic Meter
<b>mi<sup>2</sup></b>	Square Miles
<b>MPa</b>	Megapascals
<b>MRTFB</b>	Major Range Test Facility Base
<b>MSL</b>	Mean Sea Level
<b>NAAQS</b>	National Ambient Air Quality Standards
<b>NAPS</b>	Noise Assessment and Prediction System
<b>ND</b>	Not Determined
<b>NEPA</b>	National Environmental Policy Act
<b>NEW</b>	Net Explosive Weight
<b>NO<sub>2</sub></b>	Nitrogen Dioxide
<b>NTU</b>	Nephelometer Turbidity Units
<b>O<sub>3</sub></b>	Ozone
<b>OB/OD</b>	Open Burn/Open Detonation
<b>Pb</b>	Lead
<b>PBCA</b>	Primary Bomb Containment Area
<b>PEA</b>	Programmatic Environmental Assessment
<b>PLS</b>	Pure Live Seed
<b>PM<sub>10</sub></b>	Particulate Matter Less than 10 Microns in Diameter
<b>PM<sub>2.5</sub></b>	Particulate Matter Less than 2.5 Microns in Diameter
<b>POC</b>	Point of Compliance
<b>PPCA</b>	Primary Projectile Containment Area
<b>ppm</b>	Parts per Million
<b>PQL</b>	Practical Quantitation Limit
<b>psi</b>	Pounds per Square Inch
<b>RBC</b>	Risk-Based Criteria
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>RCW</b>	Red-cockaded Woodpeckers
<b>RDX</b>	Hexahydro-1,3,5-trinitro-1,3,5-triazine
<b>SA</b>	Surficial Aquifer
<b>SAR</b>	Synthetic Aperture Radar
<b>SFS</b>	SubFloridan System
<b>SHPO</b>	State Historic Preservation Office
<b>SO<sub>2</sub></b>	Sulfur Dioxide
<b>TA</b>	Test Area
<b>TMDL</b>	Total Maximum Daily Loads
<b>TNB</b>	Trinitrobenzene
<b>TNT</b>	2,4,6-trinitrotoluene
<b>TP</b>	Training Projectile
<b>µg/L</b>	Micrograms per Liter
<b>µg/m<sup>3</sup></b>	Micrograms per Cubic Meter
<b>UFA</b>	Upper Floridan Aquifer
<b>USAF</b>	U.S. Air Force
<b>USDA</b>	U.S. Department of Agriculture
<b>USEPA</b>	U.S. Environmental Protection Agency
<b>USFWS</b>	U.S. Fish and Wildlife Service
<b>UWB</b>	Ultra Wideband
<b>UXO</b>	Unexploded Ordnance
<b>VAM</b>	Vesicular-Arbuscular Mycorrhizae
<b>WQLS</b>	Water Quality Listed Segments

## 1. PURPOSE AND NEED FOR ACTION

### 1.1 INTRODUCTION

The Eglin Military Complex is a Department of Defense (DoD) Major Range Test Facility Base (MRTFB) that exists to support the DoD mission (Figure 1-1). Its primary function is to support research, development, test, and evaluation of conventional weapons and electronic systems. Its secondary function is to support training of operational units. Eglin range components include:

- 1) Test Areas/Sites
- 2) Interstitial Areas (areas beyond and between the test areas)
- 3) The Eglin Gulf Test Range
- 4) Airspace (over land and water)

The Air Force Air Armament Center (AAC) has responsibility for the Eglin Military Complex and for all its users, which include DoD, other government agencies, foreign countries, and private companies. For range operations, AAC provides environmental analyses and necessary National Environmental Policy Act (NEPA) documentation to ensure compliance with Air Force policy and applicable federal, state, and local environmental laws and regulations.

AAC includes two wings and four directorates that collectively operate, manage, and support all activities on the Eglin Military Complex. AAC accomplishes its range operations through the 46<sup>th</sup> Test Wing with support from the 96<sup>th</sup> Air Base Wing. The 46<sup>th</sup> Test Wing Commander is responsible for day-to-day scheduling, executing, and maintaining of this national asset. The continued DoD utilization of the Eglin Military Complex requires flexible and unencumbered access to land ranges and airspace, which support all of Eglin's operations. Eglin controls airspace overlying 127,868 square miles (mi<sup>2</sup>), of which 2.5 percent (3,226 mi<sup>2</sup>) is over land and 97.5 percent (124,642 mi<sup>2</sup>) is over water as shown in Figure 1-1.

The 46<sup>th</sup> Test Wing is analyzing the cumulative environmental impacts of all current and anticipated future operations conducted on Test Area (TA) C-62 (Figure 1-2) in this Programmatic Environmental Assessment. The environmental analysis of TA C-62 mission activities is part of the development of a range *Living Environmental Baseline* to support the diverse array of warfighters that use the Eglin Military Complex for research, development, testing, evaluation, and training. All mission operations (known as effectors) and physical and biological resources (known as receptors) are detailed within the *Test Area C-62 Environmental Baseline Document* (U.S. Air Force, 2000).

It is often assumed that the identification of impacts will stop a project; in reality, it is the failure to do so that creates vulnerability under NEPA. The full disclosure of impacts does not stop a program or project under NEPA; however impact disclosures could trigger other environmental statutes that may have an effect. NEPA can delay projects and programs through injunctive relief if analysis is done superficially or not at all. Full disclosure in combination with informed decisions actually protects the decision-makers' overall vulnerability. Under the auspices of the AAC 46<sup>th</sup> Test Wing, it is the intent of this analysis to provide scientific data and analysis in a manner that informs and assists decision-makers.

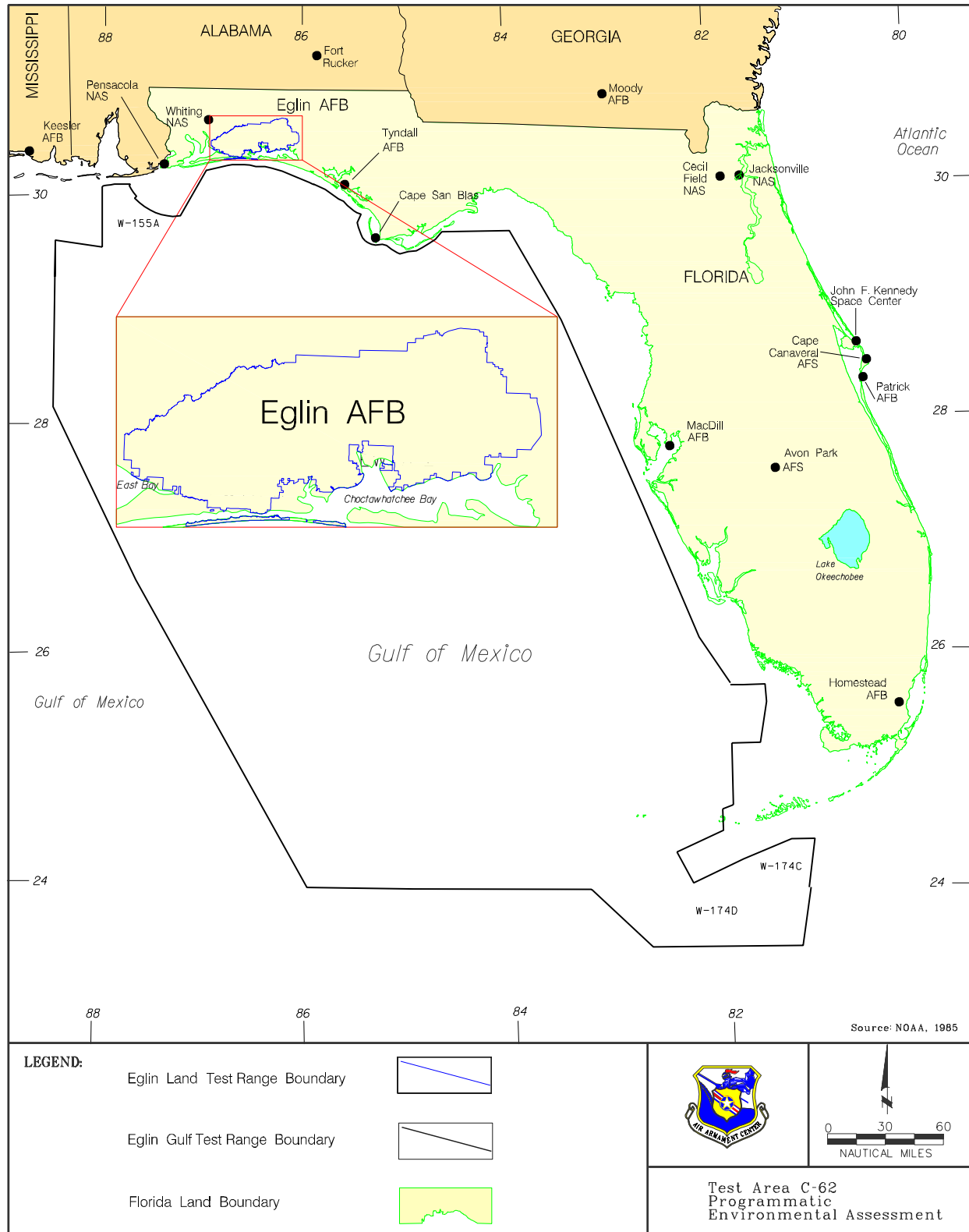


Figure 1-1. The Eglin Military Complex

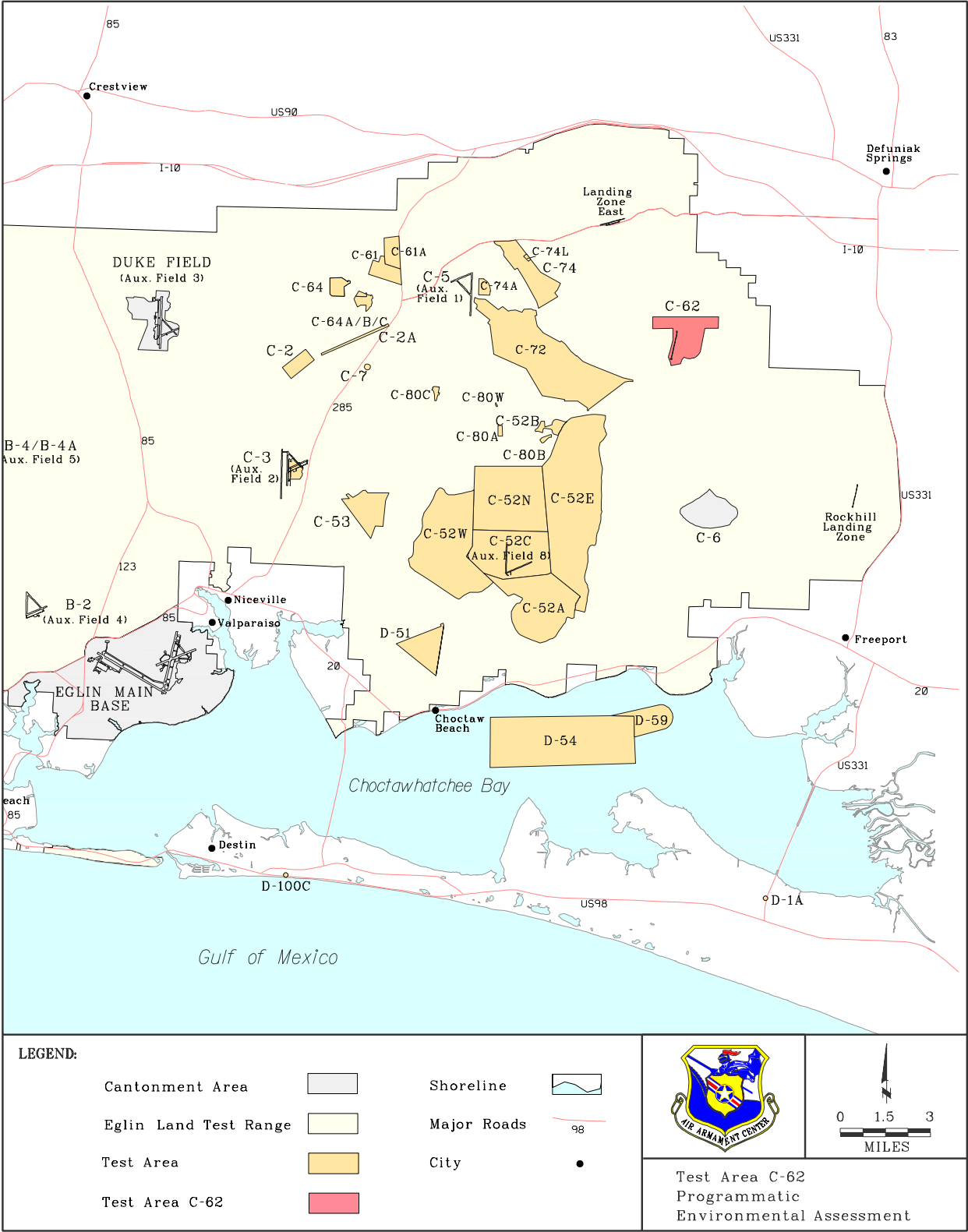


Figure 1-2. Eglin Land Test Areas and TA C-62, the Region of Influence

## 1.2 PROPOSED ACTION

The proposed action is for the 46<sup>th</sup> Test Wing Commander to establish an authorized level of activity at TA C-62 based on an anticipated maximum usage, with minimal environmental impacts. The purpose and need for this proposed action is two-fold. First, to quickly and efficiently process new programs requesting use of the land test areas during routine and crisis situations. The need associated with this purpose is to provide military users a quick response to priority needs during war or other significant military involvement, as well as improve the current approval process for routine uses. Second, to update the NEPA analysis by reevaluating the mission activities and by performing a cumulative environmental analysis of all mission activities. The need associated with this purpose is multifaceted and described below.

Eglin has performed environmental analyses on its mission activities on a case-by-case (i.e., each individual mission) basis since NEPA was enacted in 1970. Many of Eglin's mission activities have not ceased since the original environmental analyses were done to initiate the mission; thus no new environmental reviews have been required or performed. Currently, when approval for a new mission is requested, it may be categorically excluded from additional environmental analysis if it is similar in action to a mission that has been previously assessed and the assessment resulted in a finding of no significant environmental impact. The categorical exclusion (CATEX) designation is in accordance with NEPA and Air Force regulations (Council on Environmental Quality [CEQ] and AFI 32-7061).

Since some of these ongoing mission activities were originally assessed, and also since similar mission activities were assessed and CATEXed, changes have occurred at Eglin that could affect environmental analysis. These changes, outlined below, create a need to reevaluate the NEPA analysis individually and cumulatively.

- Additional species have been given federal and state protection status.
- Species have been discovered that were not previously known to exist at Eglin.
- Additional cultural resources have been discovered and documented.
- The population of communities along Eglin's borders has increased.
- Air Force regulations have changed.
- Military missions and weapons systems have evolved.

Additionally, with work performed during the 1990s by Eglin in conjunction with The Nature Conservancy, the Eglin ecosystems are better understood now than ever before.

While each mission has been analyzed individually, a cumulative analysis of potential environmental impacts from all mission activities has not been performed. The programmatic analysis performed in this report allows for a cumulative look at the impact on Eglin receptors from all mission activities. By implementing an authorized level of activity, sustainable range management will be streamlined and cumulative environmental impacts will be more fully considered.

### 1.3 SCOPE OF THE PROPOSED ACTION

Test Area C-62 is a 1,290-acre weapon systems testing and training area located in Walton County on the eastern section of Eglin Air Force Base, approximately 20 miles northeast of Eglin Main. Mission activities on TA C-62 have been described in the *Test Area C-62 Environmental Baseline Document* (U.S. Air Force, 2000) for the baseline period between FY95 and FY97. TA C-62 provides specialized mission support and absorbs overflow from the main land test areas. This represents an overflow capability for peak mission workload times on the larger test areas. The test area can be utilized to support air-to-ground tactical training (gunnery, rocketry, and bombing), assault landings, aircraft takeoffs and touch-and-go activities, cargo extraction, and sensor testing. The clay landing strip can be used for assault landings, cargo extraction, touch-and-go activities, and takeoffs. The test area was laid out in its present configuration in the 1940s and was primarily used to support bomb delivery and gunnery training. Moody AFB was a primary user of TA C-62 in the early 1980s.

The test area is generally configured as an air-to-surface training range in accordance with Air Force Manual 50-46, Reference 5, and serves as a training ground for pilot qualifications in high-performance aircraft bomb delivery and gun strafing. The 96<sup>th</sup> Civil Engineer Squadron (96<sup>th</sup> CES/CESD) Explosive Ordnance Disposal (CE-EOD) uses TA C-62 for Open Burning/Open Detonation (OB/OD) of waste munitions. The baseline period TA C-62 military mission training and testing operations are divided into four categories:

- **Air-to-Surface Bomb Testing and Training** – Bomb testing operations are performed to test a new weapon, fuze, upgraded guidance or sensor system, or weapons penetration capability. During FY95 and FY96 of the baseline period, 13 aircraft-delivered CBU-97s were tested on an array of test vehicles on target TT-5. The test area was also used extensively for air-to-surface bomb delivery training during the baseline period. Arrays of inert bombs ranging from 25-pound BDU-33D/Bs to 1,972 pound MK-84s were expended on four target areas. Ninety-two percent of all bomb training deliveries being expended were on target TT-1 (Figure 1-3).
- **High Performance Aircraft Gunnery Training** – Historically, the strafing range located on target TT-3 has supported .50 caliber, 20 mm, and 30 mm aircraft gunnery training. For the baseline period, 29,954 rounds of 20 mm training projectile (TP) ammunition was expended at cloth targets suspended from telephone poles at target TT-3 (Figure 1-3).
- **Missile and Rocket Ground Training Operations** – The Hurlburt Special Operations Schools and Small Arms Range Complex used the test area for 35 mm M190 missile and 66 mm LAWS rocket training activities. The shoulder-launched practice missiles and rockets were fired at metal vehicle replicas at target TT-7 (Figure 1-3). TA C-62 was also used for testing 40 mm high explosive warheads.

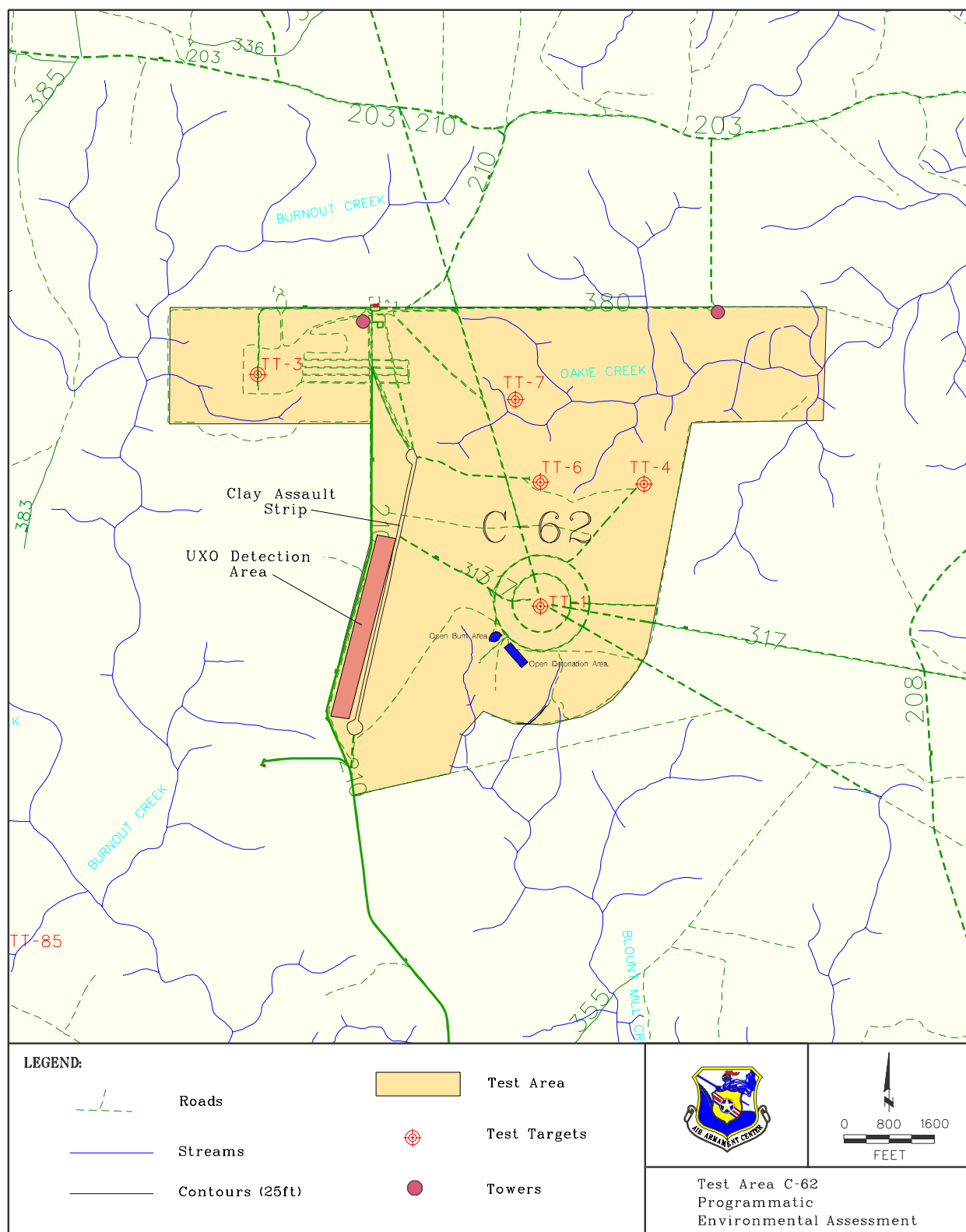


Figure 1-3. TA C-62 Military Mission Features



- **Civil Engineering Explosive Ordnance Disposal** – Test Area C-62 CE-EOD OB/OD activities are authorized under a Resource Conservation and Recovery Act (RCRA) Hazardous Waste Treatment Facility Permit issued by the Florida Department of Environmental Protection (FDEP). Under permit stipulation, there are five groundwater monitoring wells located on the site that are sampled for explosives residues quarterly (Figure 1-3). The materials typically destined for OB/OD include ordnance that has exceeded its shelf life or requires disposal for safety reasons. CE-EOD also has a role in the cleanup and disposal of test area expendables. These operations include surface and near-surface weapons ordnance cleanup and test area maintenance. Targets TT-1, TT-3, TT-4, and TT-6 are heavily littered with expended ordnance debris. Test area personnel estimate that it has been 15 years since cleanup operations have been performed on these TA C-62 target areas.

Ongoing TA C-62 military mission maintenance activities also incorporated into this assessment include test area:

- **Vegetation Maintenance** – The vegetation of TA –62 is bushhogged and roller drum chopped every other year to suppress the density and growth of native vegetation, particularly woody species. If uncontrolled, plant would grow to heights and densities that could interfere with the operation of ground-based instrumentation, obstruct observer-scoring activities, and impede munitions debris recovery.
- **Target Maintenance** – Vegetation suppression and earthmoving practices are employed to maintain the function and configuration of TA C-62 scorable targets TT-1, TT-3, TT-4, and TT-6. With the exception of aircraft gunnery strafing target TT-3, the target surfaces are periodically disturbed with heavy equipment. The contrast created between the disturbed target areas and surrounding vegetation ground cover assists in pilot recognition of the target and inert bomb impact scoring during training missions. Targets TT-1, TT-4, and TT-6 are generally maintained in a slight bowl configuration to minimize runoff. The purpose of the denuded surface (complete absence of vegetation) of target TT-3 is to facilitate the recovery of inert 20 mm and 30 mm ammunition. The configuration of TT-3 follows natural drainage contours with an outflow to Burnout Creek to the south.
- **Road Maintenance** – The test area is interlaced with active as well as abandoned roads. All TA C-62 roads are unpaved and only RR380 along the north boundary of the test area has been surfaced with crushed limestone. Generally the roads are categorized as sand surfaced tertiary or other roads. Other than RR380, attention to the maintenance requirements and environmental impact potentials of TA C-62 roads has been ignored.

## 1.4 DECISION DESCRIPTION

The 46<sup>th</sup> Test Wing wishes to authorize a level of activity for the land test areas, replacing the current approval process, which evaluates each program individually. A decision is to be made on the *level* of activity to be authorized. Currently, any new program that provides test area maintenance activities must anticipate at least a 60-day planning cycle. This period is required to complete the Test Directive, which includes the Method-of-Test, safety analysis, and the

complete the Test Directive, which includes the Method-of-Test, safety analysis, and the environmental impact analysis.

If the action does not qualify for a categorical exclusion, or if further environmental analysis is required, this process can be adjusted. Authorizing a level of activity and analyzing the effects of this level of activity may categorically exclude future similar actions from further environmental analysis. This will save both time and money in the review of proposed actions and will enable users to access the range more quickly and efficiently.

Procedures are in-place that, in time of crisis, allow the AAC Commander to authorize an accelerated process. This process reduces planning time from 60 days to 3 days. These crisis procedures operate at the expense of all other work and cause major disruptions in the process. Authorization should streamline the environmental process, enhancing Eglin's ability to quickly respond to high priority or crisis requirements.

## **1.5 ISSUES**

Issues are the general categories used to distinguish the potential environmental impacts of the effectors on the receptors. Specifically, an issue is a mission effector product, by-product, and/or emission that may directly or indirectly impact the physical, biological and/or cultural environment receptors. A direct impact is a distinguishable, evident link between an action and the potential impact, whereas an indirect impact may occur later in time and/or may result from a direct impact. The four issues that were determined to be of potential consequence to the environments of TA C-62 include noise, habitat alteration, direct physical impact, and chemical materials.

### **1.5.1 Noise**

Noise is defined for TA C-62 as the unwanted sound produced by munitions testing and training mission activities. Noise may directly inconvenience and/or stress humans and some wildlife species and may cause hearing loss or damage. Scientific data correlating the effects of noise on humans is well documented; however, information regarding the effects of noise events on wildlife species is limited. The impacts of noise to the public and on wildlife, particularly threatened and endangered species, are a primary concern.

Civil Engineering Explosive Ordnance Disposal is the primary source of noise on TA C-62 that is of potential consequence to the environment. The environmental consequences analysis is twofold: 1) evaluate the potential impacts of mission noise events on the public and sensitive wildlife species, and 2) determine the influence of unfavorable weather conditions on individual noise events.

### **1.5.2 Habitat Alteration**

Habitat alterations characterize the physical damage, stress, or disruptions that may adversely alter or degrade the habitats of TA C-62. A habitat in this instance refers to the ecologic and geomorphologic components that support organisms, vegetation, soil, topography, and water. Subsequent degradation of unique and diverse habitats may impact sensitive species. Examples

of habitat alteration include soil erosion, sedimentation of aquatic habitats, physical changes in topography, wildfires, and physical stress, injury, or mortality to the biological components of habitats. The mission activities of potential consequence to the habitats of TA C-62 include:

- Air-to-Surface Bomb Delivery Training
- High Performance Aircraft Gunnery Training
- Missile and Rocket Ground Training Operations
- Civil Engineering Explosive Ordnance Disposal
- Vegetation Maintenance
- Target Maintenance
- Road Maintenance

### **1.5.3 Direct Physical Impact**

Direct physical impact is the physical harm that can occur to an organism (plant or animal) or cultural resource as a result of mission activities. Examples include aircraft collisions with birds, vehicle-animal road collisions, crushing an organism by vehicle or foot traffic, and ordnance shrapnel or debris striking an organism. Direct physical impact is also a threat to prehistoric and historic cultural features; significant features, structures, artifacts, and site integrity may be damaged or lost due to physical disruptions. The mission activities of potential consequence to direct physical impacts on TA C-62 include:

- Air-to-Surface Bomb Delivery Training
- High Performance Aircraft Gunnery Training
- Missile and Rocket Ground Training Operations
- Civil Engineering Explosive Ordnance Disposal
- Vegetation Maintenance

### **1.5.4 Chemical Materials**

Chemical materials encompass liquid, solid, or gaseous substances that are released to the environment as a result of mission activities. These include organic and inorganic materials that can produce a chemical change or toxicological effect to an environmental receptor. Examples include gaseous air emissions (aircraft exhausts, smokes, combustion products of explosives), liquid materials (fuels and pesticides), and solid materials such as metals from ordnance and ammunition expenditures (zinc, copper, aluminum, and lead). The by-products of ordnance expenditures could potentially contaminate soil or underlying groundwater, or affect air quality.

Chemical materials primarily in the form of air emissions and metals were introduced to the environment of TA C-62 by Civil Engineering Explosive Ordnance Disposal. Potential air and soil pollutants produced by mission activity expenditures are evaluated during the environmental consequences analysis. The environmental analysis describes the amounts, extent, and concentration of chemical materials produced by these mission activities with regard to potential

impacts to vegetation, sensitive wildlife species, and surface water, groundwater, and air quality. The potential influences of the soil and water environment and food chain on the availability and translocation of chemical contaminants are also evaluated.

### 1.5.5 Debris

Debris is a physical by-product of military testing or training deposited on the surface, partially buried, or buried in the soil on impact. Debris is inclusive of inert non-hazardous materials on the surface analogous to litter and potentially hazardous surface and subsurface unexploded ordnance (UXO). Debris includes items such as shrapnel, spent casings, bomb fragments, UXO, and target or structure fragments. Depending on the composition, debris may become a chemical materials issue, or it may have human safety or aesthetic impacts. The baseline mission activities of potential consequence to debris on TA C-62 include:

- Air-to-Surface Bomb Delivery Training
- High Performance Aircraft Gunnery Training
- Missile and Rocket Ground Training Operations
- Civil Engineering Explosive Ordnance Disposal

Of particular concern to this analysis is the heavy surface accumulation of inert and UXO debris and the potential chemical material impacts of historic subsurface UXO.

## 1.6 FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

The CE-EOD munitions disposal operations are performed within a designated OB/OD unit on TA C-62 under RCRA Part B Subpart X Permit No. H046-286388. The U.S. Environmental Protection Agency (USEPA) and Florida Department of Environmental Protection (FDEP) have determined that the majority of the regulations pertaining to hazardous waste units contained in the general performance standards of 40 CFR 246, Subparts A through I, as well as Subpart X, pertaining to miscellaneous units, apply to OB/OD operations on TA C-62.

At TA C-62, a number of operations are apparent sources of erosion into surface waters, including a seepage slope bog containing state-listed threatened plant at the headwaters of Blount Mill Creek. These operations include CE OB/OD, test area maintenance (roller drum chopping), aircraft gunnery strafing, TT-3 target maintenance, and test area road maintenance. Based on a thorough review, no federal or state permits or consultations for the proposed actions are required. A comprehensive outline of relevant environmental laws, regulations, and policies taken under consideration in the development of this Programmatic Environmental Assessment are presented in Appendix B.

Nonpoint source pollution (NPS) water quality and habitat degradation impacts caused by soil erosion and sedimentation of test area streams and wetlands are associated with current TA C-62 test area maintenance roller drum chopping, aircraft gunnery strafing, TT-3 target maintenance, test area road maintenance, and CE-EOD open detonation activities. The 1999 Florida legislature produced the Florida Watershed Restoration Act (FWRA), which establishes

regulatory authority and process for listing impaired waters of the state and developing, adopting, and implementing Total Maximum Daily Load (TMDL) Plans that facilitate compliance with the Clean Water Act. Under the auspices of the FWRA, the U.S. Environmental Protection Agency can regulate NPS pollution associated with erosion and water body sedimentation. Prior to the Act, NPS compliance was primarily voluntary. A copy of the FWRA is enclosed in Appendix B.

Based on a thorough review, no Federal or State permits or consultations for the proposed actions are required. A comprehensive outline of relevant environmental laws, regulations, and policies taken under consideration in the development of this Programmatic Environmental Assessment are presented in Appendix B.

## 1.7 ENVIRONMENTAL JUSTICE

On 11 February 1994, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was issued with the directive that during the National Environmental Policy Act (NEPA) process, federal agencies adopt strategies to address the environmental concerns of minority and low-income communities that may be impacted by the implementation of federal missions. The intent of the Executive Order is to ensure that no individual or community, regardless of race, ethnicity, or economic status, should shoulder a disproportionate share of adverse environmental impacts to human health or environmental condition resulting from the execution of federal missions.

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The purpose of environmental justice is to identify disproportionately high and adverse socioeconomic and/or environmental impacts and identify appropriate alternatives.

The Executive Order also requires the application of equal consideration for Native American Programs. This may include the protection of Native American tribal lands and resources such as treaty-protected resources, cultural resources, and/or sacred sites. This issue, along with the associated public participation mechanisms, is fully addressed via Eglin's compliance with the following:

- The Antiquities Act of 1906
- The Sites Act of 1935
- The National Historic Preservation Act of 1974
- The Archaeological Resources Protection Act of 1979
- The Native American Graves and Repatriation Act of 1990
- The American Indian Religious Freedom Act

Procedures for compliance with the above laws are outlined in Eglin's Cultural Resource Management Plan (U.S. Air Force, 1997). As a result, an additional analysis was not included in this Programmatic Environmental Assessment.

In Pensacola, Florida, another type of environmental justice issue made history. A citizens group complained of pollution-induced cancer, respiratory problems, and skin rashes from a dioxin-contaminated area. While dioxin contamination and community relocation issues have been seen before in other parts of the county, the Pensacola case was the first USEPA pilot project demonstrating federal commitments to environmental justice by improving community relocation decisions (Environmental News Daily, 1996).

The access of the public to TA C-62 during mission activities is restricted regardless of socioeconomic status (for safety and security reasons), which limits adverse mission impact potentials to individuals or communities of concern. The noise produced by the baseline CE-EOD open detonation missions on TA C-62 is not anticipated to disproportionately impact low income or minority populations during favorable weather conditions. The reduction in the amount of explosives expended during a detonation associated with Alternative 3 would also substantially reduce public noise impact potentials.

Based on the language that frames the definition of the environmental justice issue, the FY95 through FY97 baseline missions performed on TA C-62 are not known to disproportionately shoulder low income or minority populations with high or adverse health, environmental, and/or socioeconomic conditions. The potential realm of influence associated with the CE-EOD missions performed on TA C-62 are indiscriminately inclusive of the diversity of ethnic and socioeconomic population variables that occur outside the boundaries of Eglin Air Force Base with no exercise of disparity toward any one group or affiliation.

## 2. ALTERNATIVES

### 2.1 INTRODUCTION

This section introduces the alternatives that will be evaluated for potential environmental impacts in the Programmatic Environmental Assessment for TA C-62. The proposed alternatives, which are analyzed in this document, are:

- **Alternative 1 (No Action Alternative):** Current level of activity as defined in the baseline period, fiscal year (FY) 95 through FY97
- **Alternative 2:** Authorize current level of activity (Alternative 1)
- **Alternative 3:** Alternative 2 plus Range Sustainability Best Management Practices (BMPs)
- **Alternative 4:** Alternative 3 plus a 100 percent increase in all missions with the exception of CE-EOD open detonation operations

The baseline was developed for each TA C-62 mission category using expenditure data from FY95 through FY97. For air-to-surface bomb testing and training, high-performance aircraft gunnery training, and missile and rocket ground training operations, the maximum annual number of expenditures among the three years was used as the baseline as shown in Table 2-1. For CE-EOD operations, the fiscal year during which the greatest net explosive weight (NEW) of munitions was expended was used as the baseline as shown in Table 2-2.

### 2.2 ALTERNATIVES CONSIDERED

This section provides a description of the alternatives that were considered during this evaluation.

#### 2.2.1 Alternative 1 (No Action): Current Level of Activity

The No Action Alternative is based on the current level of activity for a baseline described in Tables 2-1 and 2-2. This alternative is defined as continuing the current practice of analyzing each TA C-62 action on an individual basis. This process has served Eglin well and has allowed good stewardship of the Eglin resources for many years. ***This alternative does not authorize any level of activity.*** Therefore, each action is identified by the proponent and evaluated by a working group. If further environmental analysis is required, an Environmental Assessment is prepared. This is a time and resource intensive process. Crisis or surge activities can be handled reasonably quickly, but at the expense of other programs.

## 2.2.2 Alternative 2: Authorize Current Level of Activity

This alternative is defined as **authorizing** the current level of activity for the baseline described in Tables 2-1 and 2-2. Alternative 2 includes a cumulative evaluation of all activities within TA C-62. By authorizing this level of activity, similar mission requests may be quickly and efficiently approved.

**Table 2-1. Air-to-Surface, Electronic Countermeasure/Electronic Systems, and Ground Operations Annual Expenditure Baseline**

Mission		Expenditures			
Operation	Category	Munition Type	Target/ Area(s)	Fiscal Year (FY)	Number of Expenditures
Air-to-Surface Bomb and Gunnery Operations	Live Bomb Testing	CBU-97 Smart Bomb	TT-5	FY96	10
		M18 Smoke Grenades	TT-5	FY95	272
		0.5 lbs. HE C-4	CE-EOD OB/OD Unit	FY96	34
	Inert Bomb Training	BDU-33D/B	TT-1, TT-5	FY97	1,642
		GBU-10	TT-4	FY95	19
		BDU-50	TT-1	FY96	337
		MK-20	TT-1	FY97	1
		MK-82 LD	TT-1	FY97	6
		MK-84 LD	TT-1	FY96	34
		BLU-109	TT-1	FY96	2
		Gunnery Training	20 mm TP	TT-3	FY96
Subtotal				16,088	
Electronic Counter- measures and Electronic Systems Operations	Systems Testing	Flame Thrower	Parking Area	FY95	5
		Fog and Foam		FY95	3
		L8A3 Grenades		FY95	2
		MBS Smoke Pots		FY95	2
		Thermite Grenades		FY95	12
	Subtotal				24
Ground Operations	Live Missile Testing	40 mm HE	Expended at unknown locations on the test area	FY95	32
	Practice Missile and Rocket Training	35 mm M190	TT-7	FY95	2,002
		66 mm LAWS	TT-7	FY95	5
		Subtotal			
	Total				18,151



**Table 2-2. Civil Engineering Explosive Ordnance Disposal Annual Baseline Number of Expenditures and Net Explosive Weight (NEW)\***

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW (pounds)
<b>Small Arms Ammunition</b>	.38 Cal SP Ball	FY96	1,102	0.00
	.50 Cal AP	FY97	1	0.00
	.50 Cal API	FY96	304	0.00
	5.56-mm Ball	FY96	58,889	0.00
	5.56-mm Blanks	FY96	392	0.00
	7.62-mm Ball	FY95	733	0.00
	7.62-mm Blanks	FY97	155	0.00
	<b>Subtotal</b>		<b>61,576</b>	<b>0.00</b>
<b>Gun Ammunition</b>	20 mm TP	FY97	3,664	0.00
	20 mm HEI	FY97	7	0.20
	25 mm TP	FY96	270	0.00
	30 mm HEI (PGU-13/B)	FY97	649	66.13
	30 mm TP (PGU-15/B)	FY96	7,139	0.00
	40 m HEI (PGU-9/B)	FY97	28	24.36
	40 mm AP M81A1	FY96	156	112.32
	57 mm CTG, HE	FY97	6	8.49
	105 mm HE	FY96	1	15.70
	115 mm Live	FY96	4	14.90
	<b>Subtotal</b>		<b>11,924</b>	<b>242.10</b>
<b>Bombs</b>	BDU-33	FY96	1,500	124.50
	BLU-107 Durandall Live	FY97	11	880.00
	BLU-108 Submunition CBU-97 Live	FY96	80	80.00
	BLU-109, Inert	FY96	600	0.00
	BLU-110A/B, Live	FY96	1	445.00
	MK-82, Live	FY96	6	1,152.00
	MK-82 GP, Inert	FY97	4	0.00
	MK-83, Inert	FY97	1	0.00
	MK-84, Live	FY97	1	945.00
	MK-84 LD, Inert	FY97	3	0.00
	Pipe Bomb, 100 LB HE	FY96	2	200.00
	Samanta Submunitions Motor	FY97	1	0.00
	<b>Subtotal</b>		<b>2,210</b>	<b>3,826.50</b>
<b>Missile</b>	Smokey Sam Rocket Motor	FY97	297	0.00
	2.75 Inch Rocket Motor	FY97	126	0.00
	<b>Subtotal</b>		<b>423</b>	<b>0.00</b>
<b>Flares</b>	Distress Flare	FY97	131	10.64
	LUU-2	FY97	1	22.00
	M-206	FY97	5	1.43
	MK-6	FY96	9	36.00
	MK-25	FY97	15	30.00
	MK-58	FY96	1	4.85
	MJU-7	FY96	41	25.74
	MJU-10	FY97	114	228.00
	<b>Subtotal</b>		<b>317</b>	<b>358.66</b>
<b>Propellant (lb.)</b>	M-30	FY96	2,555	0.00
	1 Pound	FY97	1,412	0.00
	<b>Subtotal</b>		<b>3,967</b>	<b>0.00</b>

\*NEW = Net Explosive Weight (pounds)

Continued next page

**Table 2-2. Civil Engineering Explosive Ordnance Disposal Annual Baseline Number of Expenditures and Net Explosive Weight (NEW) Cont'd\***

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW (pounds)
Smoke	Smoke Grenades, M18	FY97	23	16.56
	MK-13 Marine Signal	FY96	120	25.44
	Smoke Pot	FY97	60	1,920.00
	<b>Subtotal</b>		<b>203</b>	<b>1,962.00</b>
Explosives (lb.)	Black Powder (lbs.)	FY97	40	40.00
	Waste Explosives	FY96	10	10.00
	Waste Explosive, HERD (lbs.)	FY97	3,356	3,356.00
	OCTOL	FY97	44	44.00
	Comp. B HE, (lbs.)	FY97	113	113.00
	<b>Subtotal</b>		<b>3,563</b>	<b>3,563.00</b>
Explosive Sheets	Sheets	FY96	1	20.00
	Detasheets®	FY96	175	282.00
	<b>Subtotal</b>		<b>176</b>	<b>302.00</b>
C-4 (lb.)	5 lbs. HE	FY96	471	2,355.00
	1 lb. HE	FY97	60	60.00
	<b>Subtotal</b>		<b>531</b>	<b>2,415.00</b>
Charge	Demo	FY95	2	2.00
	Demo M-112	FY95	5,882	7,352.50
	Demo M-183	FY95	40	800.00
	Demo TNT	FY95	662	3,310.00
	Demo 1.25 lbs HE	FY96	3,000	3,750.00
	Demo 5 lbs. HE	FY97	100	500.00
	<b>Subtotal</b>		<b>9,686</b>	<b>15,714.50</b>
Fuze	M-505	FY96	44	39.29
	MK-407	FY96	151	305.62
	FMU-124	FY96	77	20.88
	FMU-124A/B	FY97	1	0.27
	FMU-135/B	FY96	4	7.88
	FMU-139A/B	FY96	4	1.11
	FMU-143B/A	FY97	4	1.08
	FMU-153	FY96	17	13.11
	Blasting Time	FY95	2,898	7.82
	FZU-1/B Booster	FY95	41	0.41
	<b>Subtotal</b>		<b>3,241</b>	<b>397.47</b>
Blasting Cap	Electric M	FY95	53	0.15
	NON-EL	FY95	463	1.25
	<b>Subtotal</b>		<b>516</b>	<b>1.40</b>
Detonator	IDT-199	FY96	149	1.86
	RP-1	FY97	153	0.20
	<b>Subtotal</b>		<b>302</b>	<b>2.06</b>
Detonation Cord (feet)	Cord (feet)	FY5	8,482	78.88
	MK-120	FY97	72,400	7.24
	MK-140	FY96	333	14.65
	MK-143	FY96	190	16.25
	MK-149	FY96	48	37.02
	<b>Subtotal</b>		<b>81,453</b>	<b>154.04</b>

\*NEW = Net Explosive Weight (pounds)

Continued next page

**Table 2-2. Civil Engineering Explosive Ordnance Disposal Annual Baseline Number of Expenditures and Net Explosive Weight (NEW) Cont'd\***

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW (pounds)
Impulse Cartridge	BBU-35	FY96	136	0.11
	BBU-36	FY97	192	0.42
	MK-2	FY96	44	0.61
	MK-9	FY96	525	9.82
	Squib RR-136	FY96	396	0.59
	MK-2 MOD 1	FY97	134	1.86
	<b>Subtotal</b>		<b>1,427</b>	<b>13.41</b>
Other	CTG Cal .50 AP M2	FY95	98	3.32
	CTG, Impul. .50 Cal.	FY97	40	0.97
	Time Igniter	FY95	330	0.03
	ARD-446 Squib	FY97	4,289	118.38
	ARD-863 Squib	FY96	289	2.60
	Primer, M-23A2	FY96	11,127	16.69
	Booster MK-339	FY96	68	709.38
	GND Burst SIM	FY96	2,998	422.72
	Reactive Armor	FY97	119	253.18
	Terminal Battery	FY97	33	0.00
	<b>Subtotal</b>		<b>19,391</b>	<b>1,527.27</b>
			<b>Total</b>	<b>30,437.00</b>

\*NEW = Net Explosive Weight (pounds)

Alternative 2 TA C-62 military mission impacts and potential impacts include:

- DeFuniak Springs residential areas with a population density of >39 individuals per square mile and one hospital and one school are subject to exposure to 115 dBP noise generated by CE-EOD open detonation events under favorable weather conditions.
- Florida burrowing owl nest(s) in the Oakie Creek area is subject to exposure to 152 dBP noise generated by CE-EOD open detonation events.
- Military mission activities and mission support services induced sediment loading has altered the stream morphology, water quality, and habitat utility of Blount Mill Creek, Oakie Creek, and Burnout Creek. CE-EOD OB/OD operations, target maintenance, road maintenance, and test area vegetation management roller drum chopping have created landscape altering soil erosion and sedimentation from four primary TA C-62 Erosion Impact Areas (EIA-1, EIA-2, EIA-3, and EIA-4). These EIAs have compromised the long-term capability of these areas to support mission activities and increased nonpoint source pollution of on-site and off-site streams and wetlands.
- Sediment encroachment associated with CE-EOD OB/OD operations and EIA-1 threatens the viability of a sensitive seepage slope bog wetland along the western headwater of Blount Mill Creek; state listed threatened plant species have been identified at the site.
- The destruction of active and inactive gopher tortoise burrows and tortoise nest egg clutches by vegetation management roller drum chopping every other year could reduce the availability and integrity of habitats used by various state and federal listed species, such as the threatened eastern indigo snake, compared to undisturbed areas.

- Direct physical contact between vegetation management roller drum choppers and sensitive species would likely result in a 100 percent probability of species death or serious injury.
- Explosive residue in groundwater downstream of the CE-EOD OB/OD site has been detected in groundwater monitoring wells at concentrations that exceed Florida standards and/or CE-EOD OB/OD unit permit criteria.
- The presence of groundwater at the bottom of a CE-EOD OB/OD unit open detonation pit exposes groundwater to direct contamination by explosive residues.
- The metal casings of UXO originating from historic target TT-1 bombing operations and CE-EOD OB/OD events are susceptible to rupture during the time of ground impact, or corrosion and release of explosives into soil and water environments.
- TNT reduction transformation products and metabolites detected in CE-EOD OB/OD unit groundwater monitoring wells could become phototoxic to some aquatic species following exposure to sunlight.
- Unrecovered surface debris generated by CE-EOD OB/OD operations is a potential safety hazard and potential source of surface water and groundwater contamination.

### 2.2.3 Alternative 3: Alternative 2 Plus Range Sustainability Best Management Practices

Alternative 3 includes the activities proposed in Alternative 2 as shown in Tables 2-1 and 2-2, with the addition of proposed range sustainability BMPs designed to restore damaged ecosystems; conserve cultural, soil, and wildlife resources; reduce public noise impact potentials; and protect water quality and sensitive habitats associated with TA C-62. The proposed BMPs are presented as practical options for addressing TA C-62 specific concerns and not a mandate of action to be performed.

Alternative 3 was developed on the premise that the purpose of TA C-62 is to provide long-term support for current and future military testing and training missions. Since the natural landscape is the physical platform used for performing TA C-62 testing and training missions, it is evident that mission sustainability is partly dependent on active stewardship of TA C-62 air, water, soil, and biological resources that characterize TA C-62 ecosystems. Therefore the primary goal of Alternative 3 is to maximize the long-term range sustainability of TA C-62 by fostering the development and maintenance of self-sustaining ecosystems capable of absorbing and recovering from periodic mission impacts and empowering flexibility in the development of long-term test area mission support capabilities. Chapter 3 – Affected Environment provides a detailed discussion of cultural and natural resources within the realm of influence of TA C-62.

Based on ground-truthing of environmental sensitivities, analysis of best available scientific data, and modeled projections, proactive range sustainability BMPs were developed as practical methods for attaining a relative balance between environmental stewardship and military mission requirements. TA C-62 range sustainability management categories include:

- *Erosion Impact Area Restoration:* Maximize the capability of test area lands to support and recover from test area testing and training missions and minimize potentials for violating federal and state water quality standards.

- *Grassland/Shrubland Integrated Vegetation Management:* Actions are proposed to chemically control woody vegetation and maintain herbaceous ground cover through periodic prescribed burns.
- *Wetland Management:* Actions are proposed to enhance and maintain seepage bog and stream riparian wetland habitat and water quality functions.
- *Contaminant Management:* Actions are proposed to minimize munitions residue exposure to streams and groundwater and maximize the naturally engineered capabilities of biological systems to immobilize, degrade, and metabolize chemical materials.
- *Noise Management:* Action is proposed to reduce public exposure to mission related noise.

A summary of proposed range sustainability BMPs is presented in Table 2-3 with references to descriptive text in other portions of this document and illustrated in Figure 2-1.

**Table 2-3. Alternative 3 Range Sustainability Best Management Practices**

Management Category	Environmental Sensitivity Assessment			Recommended BMPs	
	Issues	Document References	Application Area(s)	Practices	Appendix A Reference
Erosion Impact Area Restoration	Accelerated stream slope soil erosion and wetland and stream sedimentation associated with CE-EOD open detonations, road maintenance, target TT-3, and roller drum chopping	3-61 4-48 4-84 Figure 2-1 Figure 3-34 Figure A-2	Erosion Impact Areas (EIA): EIA-1: Blount Mill Creek CE-EODOB/OD site EIA-2: Oakie Creek Ridge Road EIA-3: Oakie Creek North Boundary RR 380 EIA-4: Burnout Creek Target TT-3	Stream Slope Restoration	A-2
				Vegetative Runoff Barriers	A-10
				Oakie Creek Ridge Road (EIA-2) Obliteration and New Road Construction	A-12
				Oakie Creek RR 380 (EIA-3) Obliteration	A-12
Grassland/Shrubland Vegetation Management	Areas of sparse vegetative cover primarily associated with roller drum chopping and absence of fire management	3-81 4-48 4-60 Figure 2-1 Figure 3-11 Figure A-3	All test area grassland/shrublands excluding streams, wetlands, and designated buffer zones	Integrated Vegetation Management	A-16
				Hexazinone Herbicide Application	A-16
				Prescribed Burning	A-24
Wetland Habitat Management	Degradation of sensitive seepage slope bogs and stream baygall wetlands associated with sedimentation and absence of wetland fires	3-22 4-48 4-84 Figure 2-1 Figure 3-11	Headwaters of Burnout Creek, Oakie Creek, and Blount Mill Creek	Stream Slope Restoration	A-2
				Extent of Disturbance Boundary Markers	A-26
				Wetland Prescribed Burning	A-26
Contaminant Management	High density of surface UXO, potential historic UXO, and documented groundwater explosive residue contamination	UXO 3-53 4-84 IRP/AOC 3-51 4-84 Figure 3-26 Figure A-4	CE-EOD OB/OD area, target TT-1, and EIA-1	CE-EOD OB/OD Area Surface UXO and Debris Recovery	A-28
				CE-EOD OB/OD Unit Soil Disturbance Management	A-28
				Phytoremediation Groundwater Stabilization/Treatment System	A-30
Noise Management	Potential exposure of the public to CE-EOD open detonation noise >115 dBP during favorable and unfavorable weather conditions	3-47 4-25 Figure 4-6	CE-EOD OB/OD Unit	CE-EOD Open Detonation Event NEW Limits	A-32

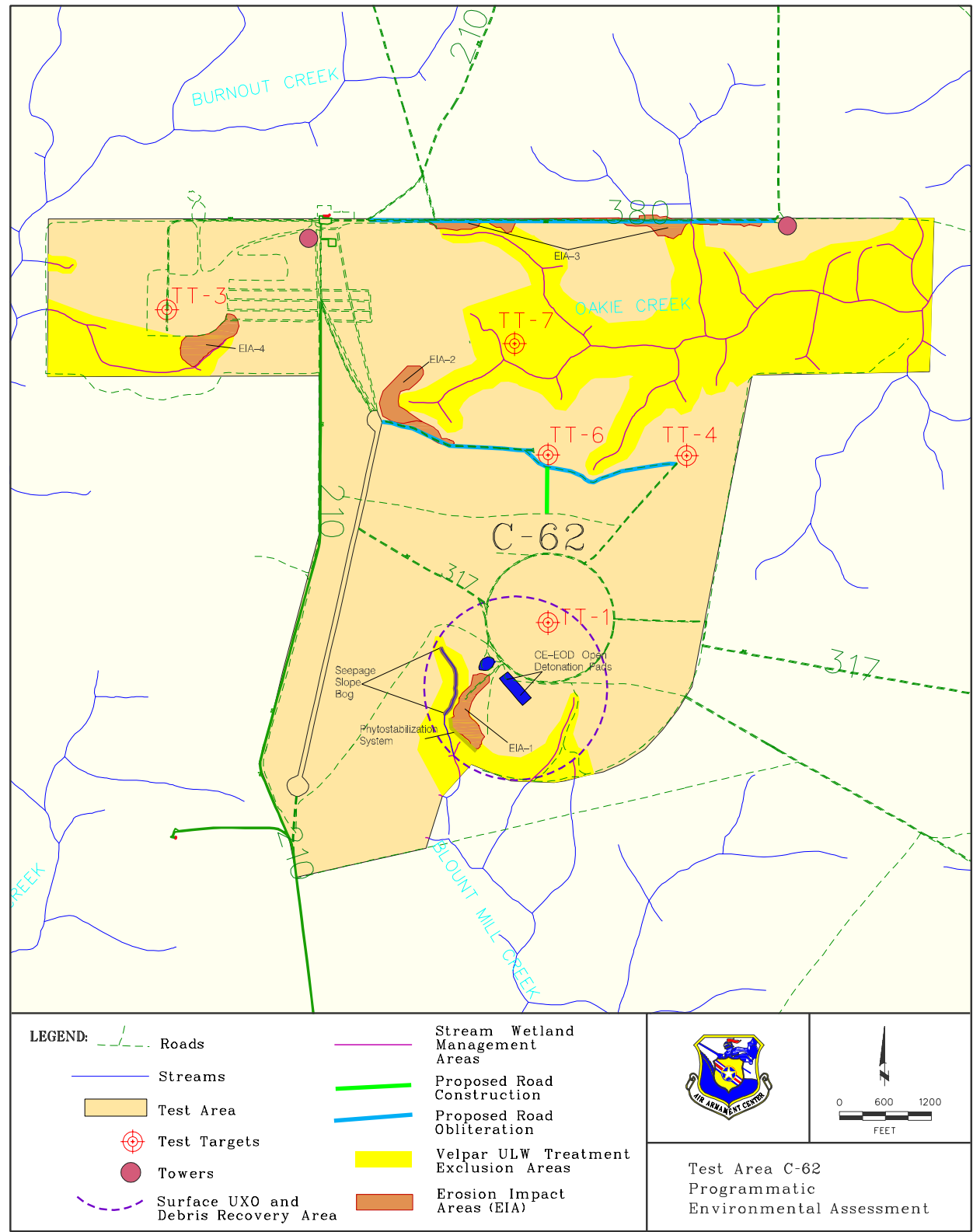


Figure 2-1. Alternative 3 Proposed Best Management Practices

With an overall goal to maximize the capabilities of TA C-62 to support current and future mission requirements while minimizing adverse impacts to environmental and regional resources, the action-specific objectives of Alternative 3 are to:

- Restore severely eroded Erosion Impact Area stream slopes to native grassland/shrubland vegetation and implement runoff, erosion, and sediment control practices that stabilize slopes, restore soil productivity, and minimize the loss of nonrenewable soil resources and potential for nonpoint source pollution of wetland and aquatic resources.
- Improve the coverage and conditions of TA C-62 terrestrial grassland/shrublands by eliminating surface disturbances and soil erosion associated with roller drum chopping and controlling woody species using hexazinone herbicide application and prescribed burning.
- Protect the high quality seepage slope bog habitat along the western stream headwater segment of Blount Mill Creek and improve the quality of stream baygall wetland habitats by restoring eroding stream slopes, designating the limits of surface disturbance, and prescribed burning of stream wetlands.
- Restore, protect, and enhance the pollutant retention and transformation water quality functions of TA C-62 stream riparian and seepage slope wetlands associated with the western headwater stream of Blount Mill Creek and the baygall wetlands associated with Oakie Creek and Burnout Creek.
- Reduce CE-EOD OB/OD site soil and groundwater contamination potentials associated with chemical residues by minimizing open detonation soil excavation potentials, installing a riparian zone phytoremediation groundwater stabilization/treatment system, and implementing stream slope restoration techniques.
- Reduce TA C-62 surface UXO and debris contamination by recovering surface munitions debris to reduce potential explosive residue contamination of groundwater and surface waters.
- Minimize potential public exposure to CE-EOD open detonation noise greater than 115 dBP by limiting open detonation events to 1,000 pounds combined NEW.

The implementation of Alternative 3 BMPs would maximize the capability of the TA C-62 environment to service current and future military mission needs (absorb and recover from mission impacts) by managing the physical and biological stability of test area lands. The potential for off-site impacts would also be minimized. Environmental sensitivities are discussed in Chapter 3, and the range sustainability concept, upon which Alternative 3 is based, is discussed in Chapter 4. An evaluation of BMP environmental impacts is also discussed in Chapter 4.

#### **2.2.4 Alternative 4: Alternative 3 Plus a 100 Percent Increase in All Missions with the Exception of CE-EOD Open Detonation Operations**

Alternative 4 would be the same as Alternative 3 with an additional 100-percent increase in all missions above the baseline with the exception of CE-EOD open detonation operations, which would remain at baseline levels. Based on groundwater monitoring data downstream of the open

detonation unit, there is a potential for groundwater contamination from open detonation activities. The expenditures associated with Alternative 4 are presented in Table 2-4.

**Table 2-4. Alternative 4: Air-to-Surface, Electronic Countermeasure/Electronic Systems, and Ground Operations Annual Baseline Expenditures (Alternative 3 Plus a 100 Percent Increase in Baseline Expenditures)**

Mission		Expenditures			
Operation	Category	Munition Type	Target/ Area(s)	Fiscal Year	Number of Expenditures
Air-to-Surface Bomb and Gunnery Operations	Live Bomb Testing	CBU-97 Smart Bomb, Live	TT-5	FY96	20
		M18 Smoke Grenades	TT-5	FY95	544
		0.5 lbs. HE C-4	CE-EOD Area	FY96	68
	Inert Bomb Training	BDU-33D/B	TT-1, TT-5	FY97	3,284
		GBU-10	TT-4	FY95	38
		BDU-50	TT-1	FY96	674
		MK-20	TT-1	FY97	2
		MK-82 LD	TT-1	FY97	12
		MK-84 LD	TT-1	FY96	68
		BLU-109	TT-1	FY96	4
	Gunnery Training	20 mm TP	TT-3	FY96	27,462
	Subtotal				32,176
	Electronic Counter- measures and Electronic Systems Operations	Systems Testing	Flame Thrower	Parking Area	FY95
Fog and Foam			FY95		6
L8A3 Grenades			FY95		4
MBS Smoke Pots			FY95		4
Thermite Grenades			FY95		24
Subtotal				48	
Ground Operations	Live Missile Testing	40 mm HE	–	FY95	64
	Practice Missile and Rocket Training	35 mm M190	TT-7	FY95	4,004
		66 mm LAWS	TT-7	FY95	10
	Subtotal				4,078
Total				36,302	

## 2.3 COMPARISON OF ALTERNATIVES

This section presents a summary comparison of the potential impacts of each of the Alternatives. Potential impacts include noise, habitat alteration, direct physical impact, and chemical materials issues. Information concerning environmental analysis methods, rationale, criteria, scenarios, and calculations used to determine these potential impacts are found in Chapter 4, Environmental Consequences.

### 2.3.1 Alternatives 1 and 2

Analysis of the Alternative 1 and 2 military mission baseline identified the potential impacts of CE-EOD open detonation operations, test area roads, test area vegetation management, and TT-3 target maintenance as the mission activities of greatest potential consequence to the environment of TA C-62 (Table 2-5). Primary issues associated with Alternatives 1 and 2 include:

- Generation of noise that could adversely impact sensitive species and communities and institutions of the region



- Active degradation of natural resource landscape mission support systems that are essential to the long-term sustainability of TA C-62
- Mission induced nonpoint source pollution of aquatic systems
- Explosives contamination of groundwater

### 2.3.2 Alternative 3

The proposed Alternative 3 BMPs would improve TA C-62 range sustainability by implementing customized practices designed to restore the self sustaining attributes of native ecosystems and reduce public and sensitive species and habitat impact potentials. Benefits to the Air Force include:

- Application of Due Diligence towards compliance with State, Federal, and Air Force environmental policies and directives
- Increase in the long-term capability of TA C-62 to support increases and future changes in military mission activity requirements and customer expectations
- Minimizing potentials for adversely impacting the public and supporting improvements that benefit the biological and socioeconomic environments of the region

### 2.3.3 Alternative 4

The number of missions for Alternative 1 through 3 would be the same, whereas Alternative 4 would be 100 percent greater. A comparison of the potential impacts associated with Alternatives 2, 3, and 4 are presented in Table 2-5.

## 2.4 PREFERRED ALTERNATIVE

The preferred alternative is Alternative 4. This alternative provides for a 100 percent increase in all missions at TA C-62 except CE-EOD open burn/open detonation operations, which would remain the same. The proposed range sustainability BMPs would increase the mission capability of TA C-62 and increase the long-term service capability of the environment to support a diversity of military needs.

Table 2-5. Comparison of Environmental Impact Analysis Results for Alternatives Considered

Environmental Analysis		Alternatives		
Issue	Criteria	1 and 2 <sup>a</sup>	3 <sup>b</sup>	4
Noise				
Public Exposure (outside Eglin)	>115 dBP			
Favorable Weather				
Population Density (individuals per square mile)				
<3		√	√	No Change
3 to 39		√	√	
>39		√	√	
Schools (Number)		1	0	
Hospitals (Number)		1	0	
Unfavorable Weather				
Population Density (individuals per square mile)				
<3		√	√	No Change
3 to 39		√	√	
>39		√	√	
Schools		~10	~15	
Hospitals		~3	~3	
Burrowing Owl Habitat Under Favorable Weather Conditions				
Home Range (acres)	Favorable Weather Noise Levels			
>140dBP				
>152dBP				
Daytime Forging Area (acres)		614	197	No Change
>140dBP		65	2	
>152dBP		49	9	
	0	0		
Habitat Alteration: Probability of gopher tortoise burrow collapse from air-to-surface inert bomb impacts				
Burrow entrance	Probability of a tortoise burrow hit is 0 to 100%. Threshold value for a take is 20%			
BDU-33/Bs		0.3%	0.3%	0.5%
BDU-50s		0.3%	0.3%	0.5%
Subsurface burrow interior	Tons of soil loss/acre/year			
BDU-50s		0.5%	0.5%	0.9%
Blount Mill Creek Headwater EIA-1		~116 tons/acre/year	~0.3 tons/acre/year	No Change
Oakie Creek Ridge Road EIA-2	~70 tons/acre/year			
Oakie Creek North Boundary RR380 EIA3	~110 tons/acre/year			
Burnout Creek Headwater EIA-4	~77 tons/acre/year			
Grassland/Shrubland Vegetation Management	Stable soil and herbaceous ground cover on acres impacted	Increased soil erosion and woody vegetation and reduced herbaceous ground cover on ~1,163 acres	Reduced soil erosion and woody vegetation and increase herbaceous ground cover capable of supporting prescribed burns on ~1,163 acres <sup>c</sup>	No Change
Direct Physical Impact (DPI): Probability of gopher tortoise, commensal species, or tortoise nest egg clutch DPI				
Air-to-Surface inert bomb training	Probability of a DPI is 0 to 100% and threshold value for a take is 20%	0.3%	0.3%	0.5%
20 mm aircraft gunnery training		1.1%	1.1%	2.2%
35–mm M190 missile ground operations		0.2%	0.2%	0.3%
Grassland/Shrubland Vegetation Management		100%	0% <sup>d</sup>	No Change
Chemical Materials and Debris				
Air Quality				
Carbon monoxide	40 mg/m <sup>3</sup>	18 mg/m <sup>3</sup>	15 mg/m <sup>3</sup>	No Change
Nitrogen dioxide <sup>c</sup>	100 µg/m <sup>3</sup>	497 µg/m <sup>3</sup>	130 µg/m <sup>3</sup>	
Lead <sup>f</sup>	1.5 µg/m <sup>3</sup>	249 µg/m <sup>3</sup>	232 µg/m <sup>3</sup>	
Soil Quality – Mission Event Cumulative Lead	400 mg/kg	0.1 µg/m <sup>3</sup>	0.2 µg/m <sup>3</sup>	
Groundwater				
2,4-dinitrotoluene	Florida <sup>e</sup> = 0.20 µg/L	0.25 µg/L	Potential Reduction	No Change
4-amino-2,6-dinitrotoluene	Four times MDL	2.2 µg/L		
Nitroglycerin		3.7 µg/L		

√ = Potential impact

<sup>a</sup> Estimated soil concentration based on two 2,500 NEW detonation events.<sup>b</sup> Estimated soil concentration based on five 1,000 NEW detonation events.<sup>c</sup> Includes the termination of roller drum chopping and implementation of proposed Integrated Vegetation Management BMPs<sup>d</sup> Includes termination of roller drum chopping and implementation of Integrated Vegetation Management Program<sup>e</sup> Atmospheric dilution and dispersion is estimated to drastically reduce elevated nitrogen dioxide and lead air emissions concentrations within 15 minutes, even under unfavorable weather conditions.<sup>f</sup> Drinking water standard; MDL = Method Detection Limit

### 3. AFFECTED ENVIRONMENT

The 724 square miles of land area that is Eglin AFB occupies a major portion of the Northwest Florida panhandle east of Pensacola. As a consequence, Eglin has a rich diversity of unique landscapes, habitats, and species that often fall within the realm of federal and state regulatory mandates. The objective of the Affected Environment chapter is to define, inventory, and generally characterize the nature and condition of the physical, biological, and anthropogenic receptors within the realm of influence of TA C-62 and develop a framework for understanding spatial and temporal patterns. The TA C-62 affected environment parameters and sequences of discussions are listed below.

#### Physical Resources

- *Topography* – landforms and relief
- *Soils* – soil series physical and chemical characteristics
- *Hydrology* – surface water and groundwater
- *Climate* – temperature, wind, rainfall

#### Biological Resources

- *Vegetation* – flora species and communities
- *Wildlife* – fauna species and communities

#### Anthropogenic

- *Cultural Resources* – archaeological/historical evaluations
- *Anthropogenic Features* – human impact features

#### 3.1 SETTING DESCRIPTION

TA C-62 is a cleared area of approximately 1,290 acres located in Walton County, Florida, 20 miles northeast of Eglin Main. The test area is primarily used for pilot qualifications in the delivery of inert bomb and gun strafing ordnance stores from high performance aircraft and Civil Engineering Explosive Ordnance Disposal. Because of the sensitive and potentially dangerous military missions performed on TA C-62, the area is closed to public use (U.S. Air Force, 1992). Other test areas in proximity include C-74, C-72, and C-52E. Additional information on Eglin's land range is available in the *Environmental Baseline Study Resource Appendixes* (U.S. Air Force, 1995) and the *Integrated Natural Resources Draft Transitional Plan, Eglin AFB, 1998-2000* (U.S. Air Force, 1998).

The test area is an upland landform located in the Southeast United States Middle Coastal Plains. The topography is characterized as gently rolling hills and broad to narrow ridges, relatively flat to gently undulating marine and fluvial terraces, and broad to narrow basins. Slopes range from less than 1 to about 10 percent. Elevations range from 132 to 239 feet above mean sea level.

The dominant Lakeland soils that cover 78 percent of TA C-62 belong to the Entisol soil order and are characterized by a quartz sand texture throughout; excessively drained; poor soil structure; low to sterile fertility; and absence of active soil forming processes. The undifferentiated quartz sand Pliocene and Holocene geologic sediments are at the surface over most of the test area.

The test area watershed drains into Burnout Creek to the west, Oakie Creek to the northeast, and Blount Mill Creek to the south. These streams form part of the Alaqua drainage system. The northern and northeastern area of the range is drained by Oakie Creek, which originates on the range. Burnout Creek flows along the western edge of the area, and a tributary of the creek drains the northwestern portion of the range. The headwaters of Blount Mill Creek are located on the southern portion of the range. The groundwater of the Surficial Aquifer of TA C-62 is a direct contributor to the perennial streamflow of these streams. A high quality seepage slope bog, inhabited by several state listed plant species, is located on the western headwater segment of Blount Mill Creek. Water well ER-1621 is a 620 foot limited use water supply located on the north end of the test area. The water is reported to smell like rotten eggs.

The open Grassland/Shrubland ecological association dominates TA C-62. The vegetation on TA C-62 is typical of other areas on the Eglin Reservation that have been altered through clearing operations. Canopy vegetation includes *Quercus laevis* (turkey oak), *Quercus incana* (blue-jack oak), and *Diospyros virginiana* (persimmon) in the drier, cleared areas and *Magnolia virginiana* (sweet bay), *Cliftonia monophylla* (titi), and *Cyrilla racemiflora* (little leaf titi) along stream margins. The shrub layers consist of species normally considered as canopy vegetation but that have not attained tree stature. The ground cover is diverse, but species of *Graminae* *Asteraceae* (grass composites) predominate.

The interstitial areas surrounding TA C-62 primarily support upland Sandhill ecosystems. There are several old growth stands of longleaf pine in close proximity to the test area. A Florida Natural Areas Inventories (FNAI) Tier I Sandhill community is located south of the test area along Blount Mill Creek and several Tier II Sandhill communities are located along the western and eastern boundaries of TA C-62. A high quality seepage slope bog was identified on the test area western headwater segment of Blount Mill Creek. A botanical survey of the area identified two state-listed threatened wetland plant species, the red flowered pitcher plant (*Sarracenia rubra*) and water sundew (*Drosera intermedia*).

The burrowing owl and the gopher tortoise (state listed species of special concern) and the southeastern American kestrel (state listed threatened species) are known to inhabit the lands within TA C-62. During a 1994 survey of gopher tortoise burrows on TA C-62, 291 tortoise burrows (106 of which were active) were identified on the test area. The eastern indigo snake, a federally listed threatened species, is a frequent user of the gopher tortoise burrow and may occur on the test area; however no indigo snakes were identified on the test area during the 1994 survey.

Anthropogenic impacts to TA C-62 include destruction of an archaeological site, IRP/AOC Site OT-47, unexploded ordnance (UXO), and erosion impact areas. A prehistoric archaeological site was identified on TA C-62 in the 1960s by Eglin personnel, and revisited by archaeologists in 1982 in preparation for Eglin's Historic Preservation Plan. A survey of the site in 2000

determined that the site had been destroyed by erosion and is no longer considered significant. Sources of site degradation include road-induced erosion, test area maintenance, and damage associated with mission activities. Investigations of additional probable areas near mission activity sites provided no evidence of cultural resources.

Installation Restoration Program (IRP) Area of Concern (AOC) Site OT-47 is located in the southern portion of TA C-62. The site has been used since the 1960s for Civil Engineering Explosive Ordnance Disposal (CE-EOD). The site is permitted to dispose of munitions through open burning and open denotation procedures. The permitted area is primarily used for open detonation activities to destroy excess, obsolete, or unserviceable munitions, components, and energetic materials, as well as media contaminated with energetics. One up-gradient well and four point compliance wells are sampled quarterly and analyzed for explosives, nitrate/nitrite, nitrogen, total dissolved solids, total suspended solids, benzene, toluene, ethylbenzene, and xylenes. Groundwater monitoring detected 2,4-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and nitroglycerin at concentrations that exceeded screening levels over 7 years of quarterly monitoring. Exceedences were evaluated, per the Permit, and determined not to be statistically significant.

TA C-62 targets TT-1, TT-3, TT-4, and TT-6 and surrounding areas are littered with munitions debris primarily associated with air-to-surface (inert bomb) training, high performance aircraft gunnery strafing training, and CE-EOD OB/OD activities. Test area personnel estimate that it has been at least 15 years since munitions debris cleanup operations have been performed on the test area.

Four mission-related soil erosion impact areas have been identified on TA C-62 including Blount Mill Creek Headwater (EIA-1), Oakie Creek Ridge Road (EIA-2), North Boundary Access Road (EIA-3), and Burnout Creek Headwater (EIA-4). Each site is characterized by active erosion that is moving sediment directly into receiving streams and degrading land surface conditions to the point of potentially compromising the environmental sustainability of TA C-62.

A summary of the physical, biological, and anthropogenic features of TA C-62 are presented in Figure 3-1.

### **3.2 PHYSICAL RESOURCES**

This section describes the landform, soils, hydrology, and climatic features that define the physical nature and characteristics of TA C-62.

#### **3.2.1 Topography**

Panhandle Florida has been slowly emerging from the sea since at least some time in the Miocene. The age of surface sediments, therefore, is older near the Alabama and Georgia borders and becomes progressively younger towards present sea level. The floor of each stand of the sea was a relatively flat, gently seaward-sloping terrace when first exposed by the receding shoreline. Terraces are separated from each other by step-like escarpments or by subtle changes in relief. Since their emergence, terraces have been eroded and dissected by streams and rivers. Entire strata have been removed in some areas, and materials from other strata have been deposited on top of lower terraces and rearranged by the erosive power of water (Wolfe et al., 1988).

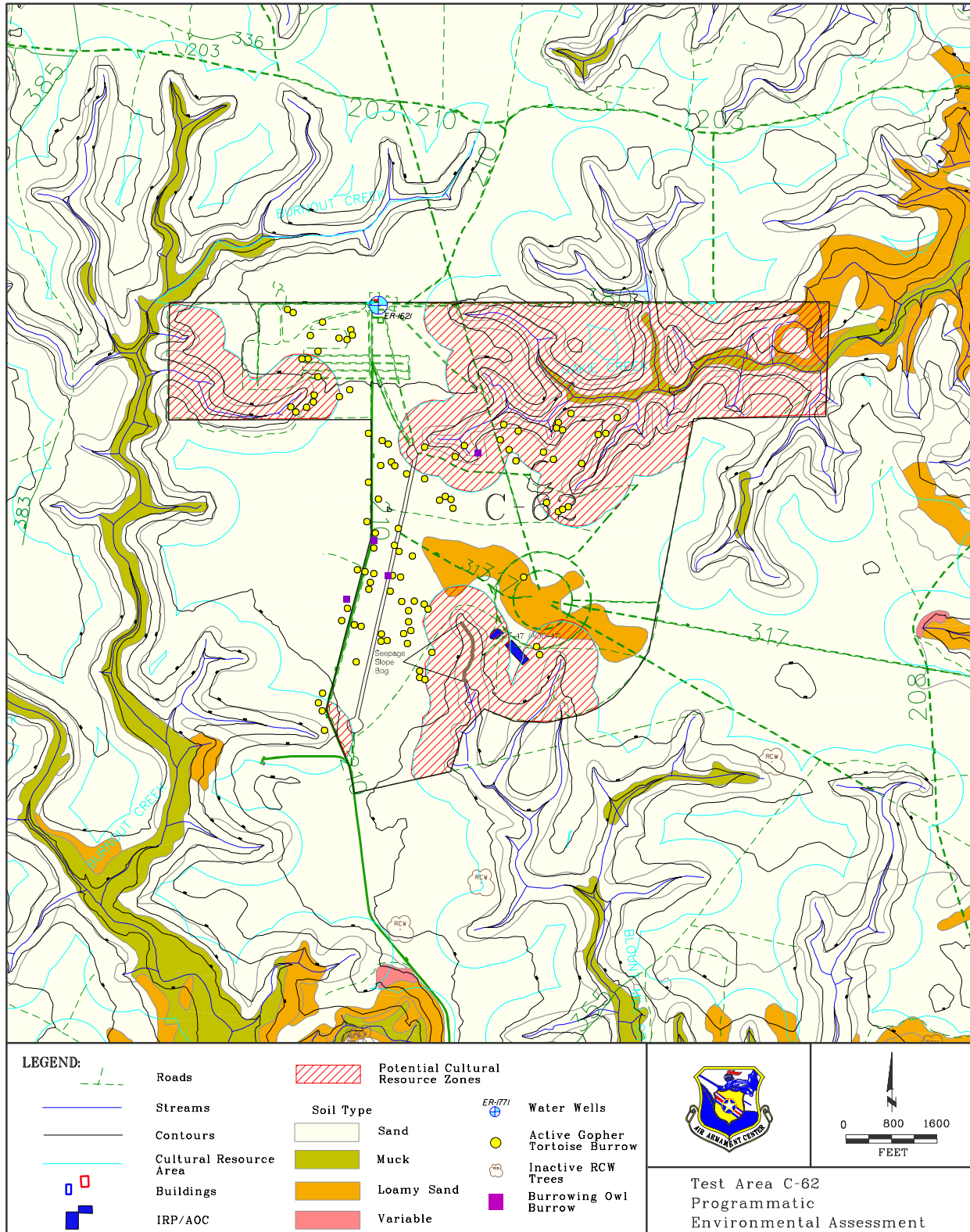


Figure 3-1. Summary of the Physical and Biological Resources and Anthropogenic Features

Test Area C-62 is located within the rolling uplands, gentle plateaus, and deep stream valleys of the Western Highlands Province (U.S. Department of Agriculture, 1989). The TA C-62 landform is generally characterized as an erosional landscape, fluvial drainage basin component. Overall, the relief on TA C-62 is characterized as gently rolling hills with relatively flat to gently undulating terraces and moderate stream basin slopes. Elevations generally range from 239 to 132 feet. The steeper slopes on the test area (10 percent) are located adjacent to Oakie and Blount Mill Creeks (Figure 3-2).

### 3.2.2 Soils

Soil formation is an on-going process that is determined by the nature of the parent material and the influence of environmental factors including climate, geology, topography, and vegetation. Soils are mapped and identified as soil series and associations. There are five soil associations composed of nine different soil series on Eglin AFB. Each association or soil type represents a soil or a group of soil types that occur together geographically and form a distinctive pattern of landscape. The soil association is dominated by one to three similar soil series and interspersed with similar areas of less extensive contrasting soil. In the association, the soil series involved occur with some degree of regularity in proportion and arrangement.

The kinds and proportions of soil series in an association influence its suitability for various land uses. A description of the primary soil series within TA C-62 is delineated in Figure 3-2 and discussed in the following narrative. The primary source of soil information was the U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Walton County Florida, (1989).

#### Lakeland Sand

The Lakeland soil covers about 1,006 acres, which is 78 percent of TA C-62's land area. This sandy, very deep, excessively drained, rapidly permeable soil formed in sandy marine, fluvial, and/or eolian sediments, occupying generally level to steep slopes ranging from 0 to 12 percent.

This soil typically contains 95 percent or more quartz or other insoluble minerals and is loose and incoherent. These soils do not have a water table within a depth of 80 inches. The key chemical and physical properties of the Lakeland soils generally include:

- $\geq 90$  percent quartz sand
- $< 1$  percent organic matter
- acidic pH (4.5 to 6.0)
- extremely low Cation Exchange Capacity (CEC) values ( $< 4$  meq/100 g)
- rapid infiltration rate
- very high permeability of 20 to 28 inches per hour

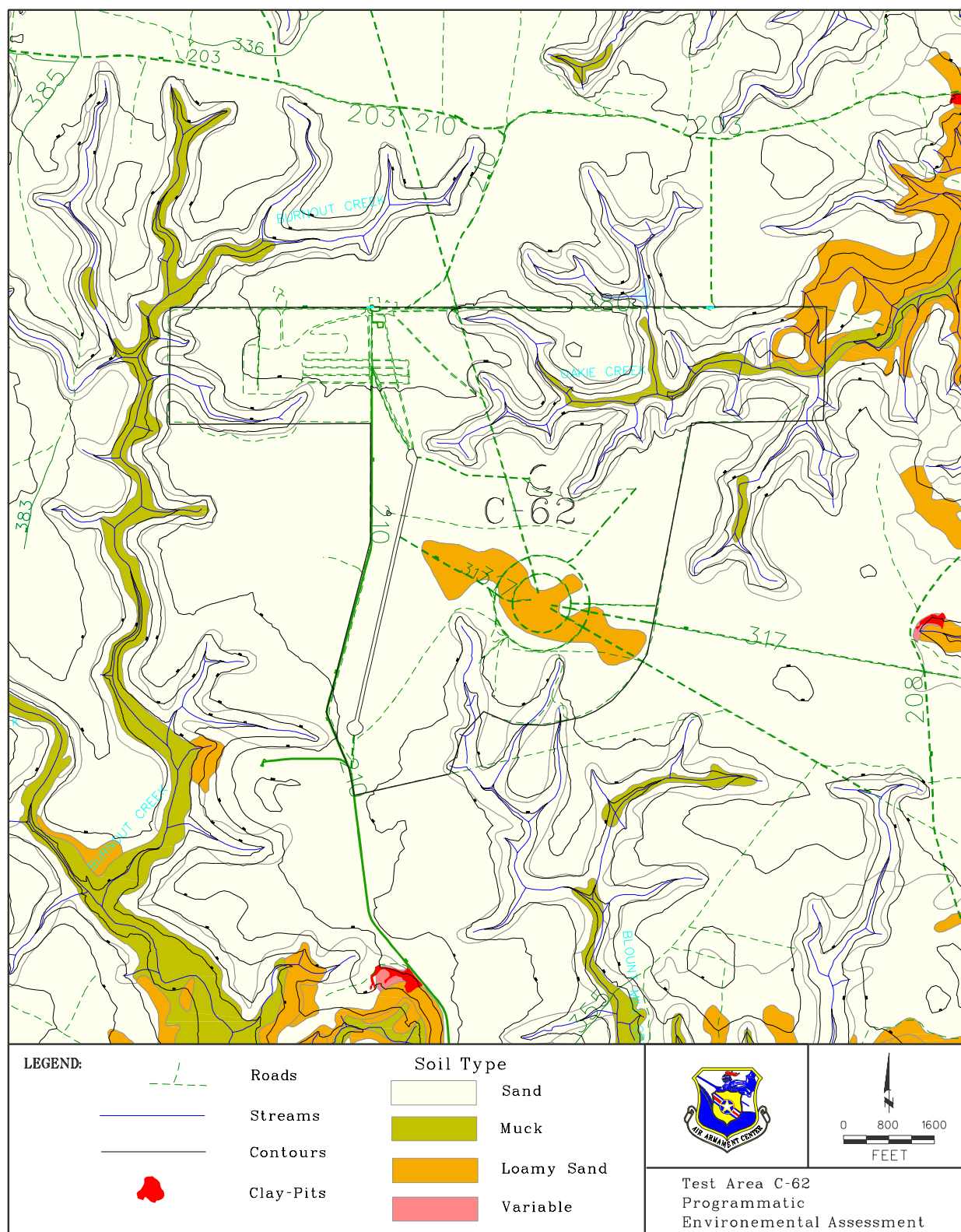


Figure 3-2. Soil Features of TA C-62



Collectively, these properties are consequential to soil formation, structure, and productivity and define thresholds beyond which damage can occur. The resulting condition of a typical Lakeland soil is generally characterized as:

- excessively drained
- poor soil structure (low cohesion, adhesion, and aggregate stability)
- very low fertility
- very high leaching potential
- relatively low diversity, activity, and populations of soil microbes (bacteria, actinomycetes, fungi, algae, protozoa), arthropods, and earthworms
- absence of active soil-forming processes

### **Troup Sand**

The 194 acres of Troup soil on TA C-62 consist of deep, somewhat excessively drained, moderately permeable soils with thick sandy surface and subsurface layers and loamy subsoils that formed in unconsolidated sandy and loamy marine sediments. Slopes are typically convex, moderate 3 percent or less, but can range to greater than 20 percent.

### **Bonifay Loamy Sand**

The 67 acres of Bonifay Loamy Sand soil occurs on the level to gently sloping ridgetops in the south central portion of the test area. The Bonifay soil is very deep, well drained, moderately slowly permeable soil that formed in thick beds of sandy and loamy marine sediments. The high water table averages 48 to 60 inches for short periods following heavy rainfall.

### **Dorovan-Pamlico Association, Frequently Flooded**

The 24 acres of Dorovan-Pamlico association soil occur in the wetlands of Oakie Creek. These soils are deep, very poorly drained, and moderately permeable. The soil association was formed from the decomposition of wood and herbaceous plant materials.

### **Other Soils**

There are minor inclusions of Rutlege Sand and Bonnearu-Norfolk-Angie Complex soils that occur at the northeastern tip of TA C-62.

### **3.2.3 Hydrology**

On a national and international scale, there is growing concern and resulting regulations that are mandating a proactive approach to protect and improve the quality of surface and groundwater sources. Florida is well known for its crystal-clear, sandy bottom streams and rivers and quality drinking water. The value of these waterways and related groundwater systems are innately linked to various environmental regulations (darter streams), socioeconomics (silviculture), aesthetics and recreation, water resources (drinking water, transportation, and irrigation), military mission activities of Eglin AFB, and other issues. The attributes of these hydrologic and

geohydrologic systems that reflect a diversity of influences are discussed in the following narrative. A summary hydrologic features map is presented in Figure 3-3.

### **Stormwater Runoff**

Generally, water deposited on the surface of TA C-62 by rainfall will infiltrate into the soil profile or move across the surface as runoff. Stormwater runoff can result in soil erosion and/or off-site transport of suspended surface contaminants. The natural tendency of water is to channelize, suspend soil particles and other materials to the degree possible, and race downhill towards stream outlets. As water gains speed, the suspended soil materials act as sandpaper, grinding away at the channel bottom and banks. Offered the opportunity to continue to concentrate, flowing water columns follow the line of least resistance, producing incisions in the landscape known as rills and gullies.

Although the TA C-62 landscape is dominated by a Lakeland soil with a sandy surface texture and rapid water infiltration rates, the terrain is still capable of producing substantial amounts of stormwater runoff. The primary driver of stormwater runoff production on the sandy Lakeland soils is not the high infiltration capacity of the soil but the limiting soil moisture content. When the actual moisture content is below the limiting soil moisture content, pore water pressure in the soil is less than atmospheric pressure and water is held in capillary form under tensile stress or suction. When the limiting moisture content is reached and all the pores are full of water, pore water pressure equates to atmospheric pressure, suction reduces to zero, and surface ponding occurs (Morgan, 1995). This explains why sandy Lakeland soils, which have low levels of capillary storage, produce storm runoffs very quickly even though their infiltration capacity is not exceeded by the rainfall intensity.

During a field survey of TA C-62, areas of concentrated erosive water flow and long-term sedimentation were observed near test area streams. TA C-62 surface runoff moves slowly over the relatively level land areas and tends to infiltrate into the loose, sandy soil before achieving concentrated flow conditions; however, the sloped landscape in proximity to streams in combination with mission related surface disturbances have created severe erosion problems.

### **Drainage Geomorphology**

The primary driver of the perennial stream flow in many Eglin streams is not surface runoff but groundwater seepage and spring flow through a highly permeable surficial medium. Although surface runoff occurs during high-intensity rainfall events, over geologic time there appears to have been a shift in the overall influences of surface hydrology and geohydrology on the landscape. During the fluctuations in sea levels of the Pleistocene Epoch, water tables were likely relatively high and surface runoff played a major role in the evolution of the landscape. However as stream channels developed and became more incised, groundwater flow within the permeable sands became dominant. Subsequently, original channels were abandoned except during major rainfall events and steephead erosion became a primary landscape development process.

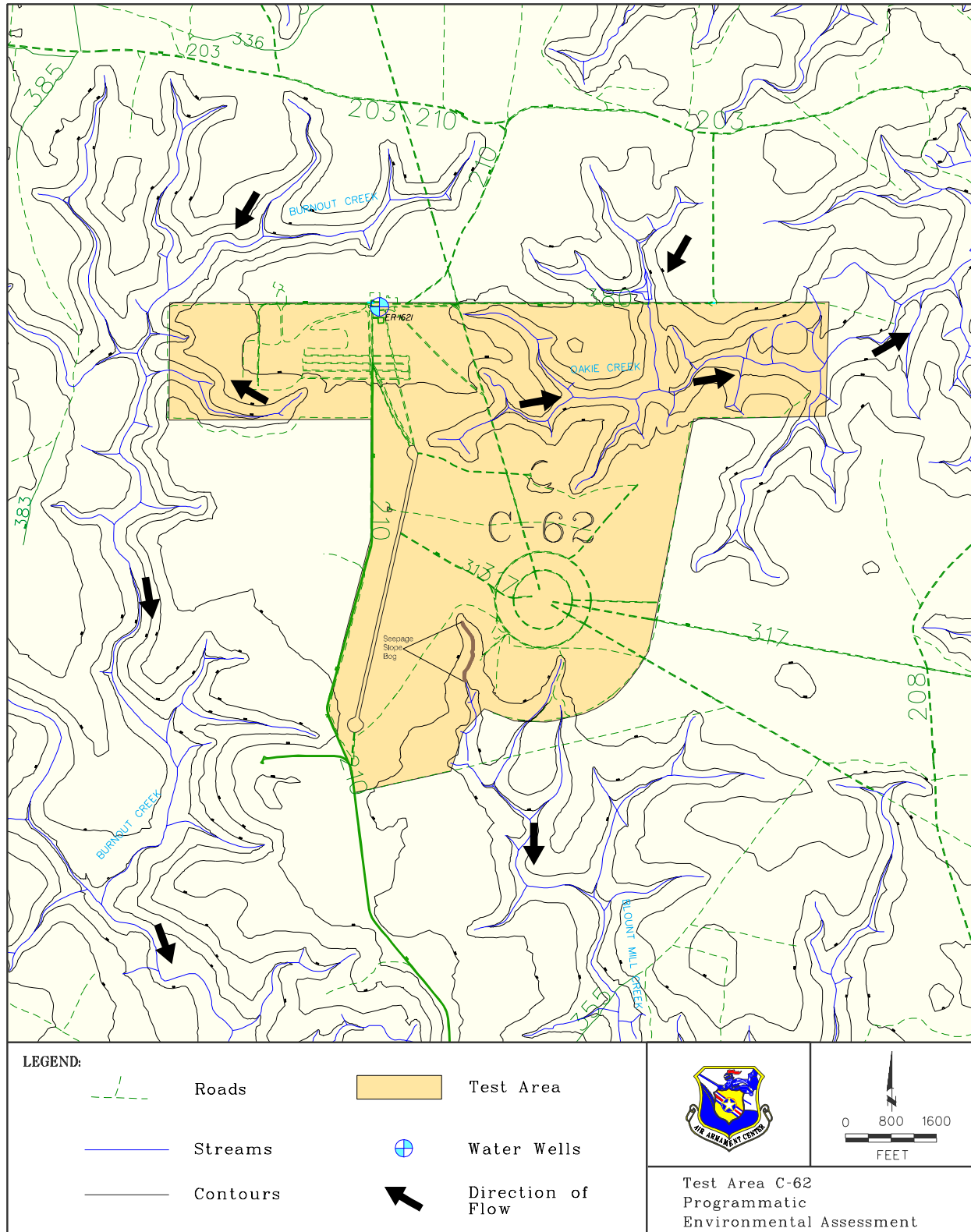


Figure 3-3. Hydrologic Features of TA C-62

In the western portion of the Eglin Reservation, steephead systems with low drainage density tend to dominate. However, moving across the Eglin reservation from west to east, the decrease in sand and increase of clay (Alum Bluff Group) in the surficial deposits has resulted in the development of a high drainage density associated with increased surface runoff. Seepage typically occurs as high valley wall seepage slope bogs or springs. The presence of perched water tables associated with clay lens also increases high valley wall seepage. TA C-62 has a high drainage density primarily associated with surface runoff.

### TA C-62 Stream Systems

Although the Floridan aquifer is not hydraulically connected to the streams of Eglin, the Surficial Aquifer is in direct hydraulic contact with the stream system of TA C-62. Generally, rainfall percolates into the Citronelle Formation and recharges the aquifer, which enters streams directly through discharge points (steepheads, springs, and seepage) along valley walls as stream baseflow. The close relationship between groundwater and surface water means streamflow remains fairly constant throughout the year (Resource Consultants and Engineers, Inc., 1993). A description of the Surficial and Floridan Aquifers and other geohydrologic features is presented in the Geohydrology section. TA C-62 directly influences three watersheds: Blount Mill Creek Watershed to the south (3,510 acres), Oakie Creek Watershed to the northeast (2,367 acres), and Burnout Creek Watershed to the northwest (2,601 acres). Headwaters for these perennial streams originate on TA C-62 (Figure 3-3).

Blount Mill Creek is a south-draining stream that merges with Little Alaqua Creek four miles south of the test area boundary. The western headwater of Blount Mill creek has been adversely impacted by mission related erosion and sedimentation. The section of the stream within the test area has become broad and braided, which is contradictory to the natural incised channel condition. A seepage slope bog occurs along both sides of the stream, and the stream passes through a Florida Natural Areas Inventory (FNAI) Tier I Pine Sandhill immediately south of the test area (Figure 3-4).

Oakie Creek is an easterly flowing stream that occupies a significant portion of the northern section of TA C-62 and merges with Alaqua Creek two miles to the east (Figure 3-5). The dense, dominant cover of titi (*Cyrilla racemifloria*) and sweetbay magnolia (*Magnolia virginiana*) along Oakie Creek is caused by an absence of frequent fires and stream sedimentation. A natural sequence of fire events produces a stream riparian vegetative system with a diverse mixture of wetland trees, shrubs, grasses, and forbs and not the dominance of overtopping shrubs and trees. Based on the density and maturity of riparian woody species, it is estimated that it has been greater than 15 years since this site burned. The widening and reduced depth of the channel created by road-induced sedimentation encourages the establishment of in-stream vegetation, which promotes further adverse alteration of the stream channel (Figure 3-6).

Burnout Creek is a four channel mile, south-draining stream that skirts the northwestern corner of the test area and merges with Little Alaqua Creek one mile southeast of the test area boundary. The channel morphology of Burnout Creek in terms of channel depth and width and aquatic habitat has been drastically altered by the introduction of sediment into the channel. The primary sediment source is accelerated erosion rates associated with target TT-3 (Figure 3-7). Water quality data for the stream systems associated with TA C-62 were not available.



**Figure 3-4. Blount Mill Creek as it leaves TA C-62 and passes through an FNAI Tier I Pine Sandhill**



**Figure 3-5. A generally closed canopy of titi and sweetbay magnolia obscure the Oakie Creek channel**



**Figure 3-6. Dense cover of woody and herbaceous vegetation within the stream channel of Oakie Creek**



**Figure 3-7. Burnout Creek instream pond formed by a sediment bar created by target TT-3 soil erosion**

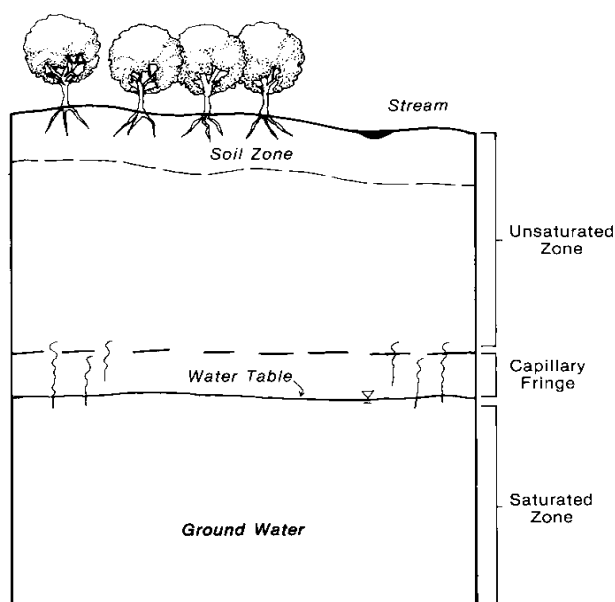
## Geohydrology

Once water moves below the realm of the surface and into the vertical zones of the soil and geologic formations, it becomes soil water and groundwater. These geohydrologic layers are known as the vadose zone (soil water) and phreatic zone (groundwater).

### *Soil Water and Groundwater*

Soil water is the unsaturated vadose zone beginning just below the surface at the point of water entry into the soil by means of infiltration. This zone is defined as unsaturated because soil pore spaces are only partially filled with water. The rate of infiltration is dependent on the soil type and amount of moisture present; a dry soil would have a relatively high infiltration rate. Following infiltration into the soil, water moves through the profile by means of percolation. Permeability is the definable quality of the soil that enables water to move through the profile that is measured in inches per hour. Surface tension and capillary forces between water and soil particles mitigate the downward movement of water toward the phreatic zone.

Beneath the vadose zone lies the phreatic or saturated zone. All the pore spaces in this zone are filled with water. The top surface of the phreatic zone is called the water table and the water below is called groundwater. Recharge occurs when surface water percolates through the soil and into the saturated zone. The delineation between these two zones will change with seasonal climatic events and variations in recharge and discharge. When the phreatic zone is capable of yielding a usable amount of water, it is called an aquifer. A representation of these zones is presented in Figure 3-8.



**Figure 3-8. Generalized Profile of Soil Water and Groundwater Zones**

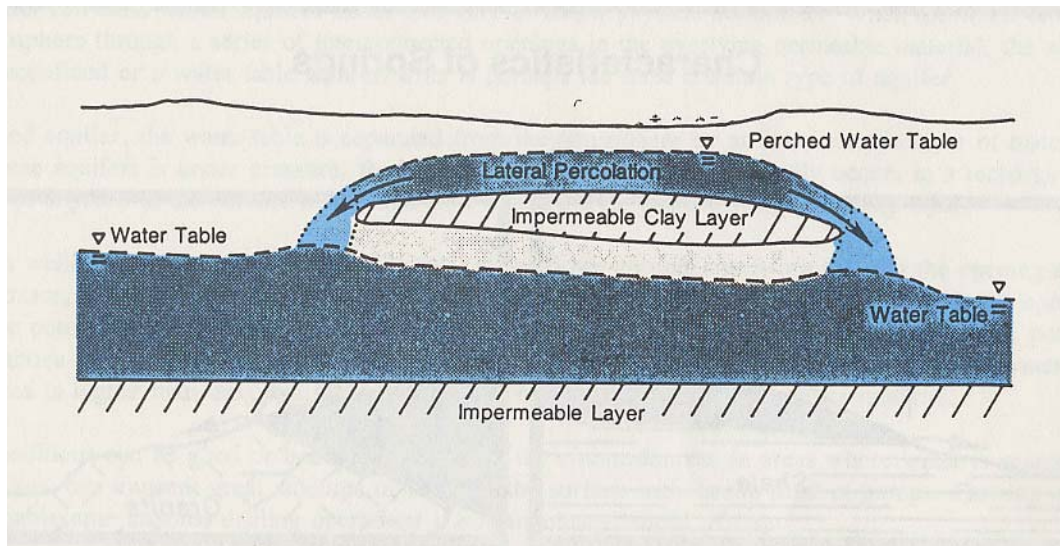
Source: U.S. Department of Agriculture, Soil Conservation Service, 1987

### ***Aquitards and Perched Water Tables***

A localized relatively impermeable lens or layer within a formation hindering the free movement of water is called an aquitard. The governing factor is low permeability and not low porosity. The presence of a low permeability material (clay layer, fragipan, etc.) within a highly permeable sand formation, can lead to the formation of a lens of saturated soil above the main water table called a perched water table.

Water moving downward is intercepted by this layer and accumulates on top of it. However, there is a finite amount of water that a perched water table can hold before water starts to seep off the trailing edges downward toward the main water table (Figure 3-9).





**Figure 3-9. Perched Water Table**

Source: USDA, 1987

### *Aquifers*

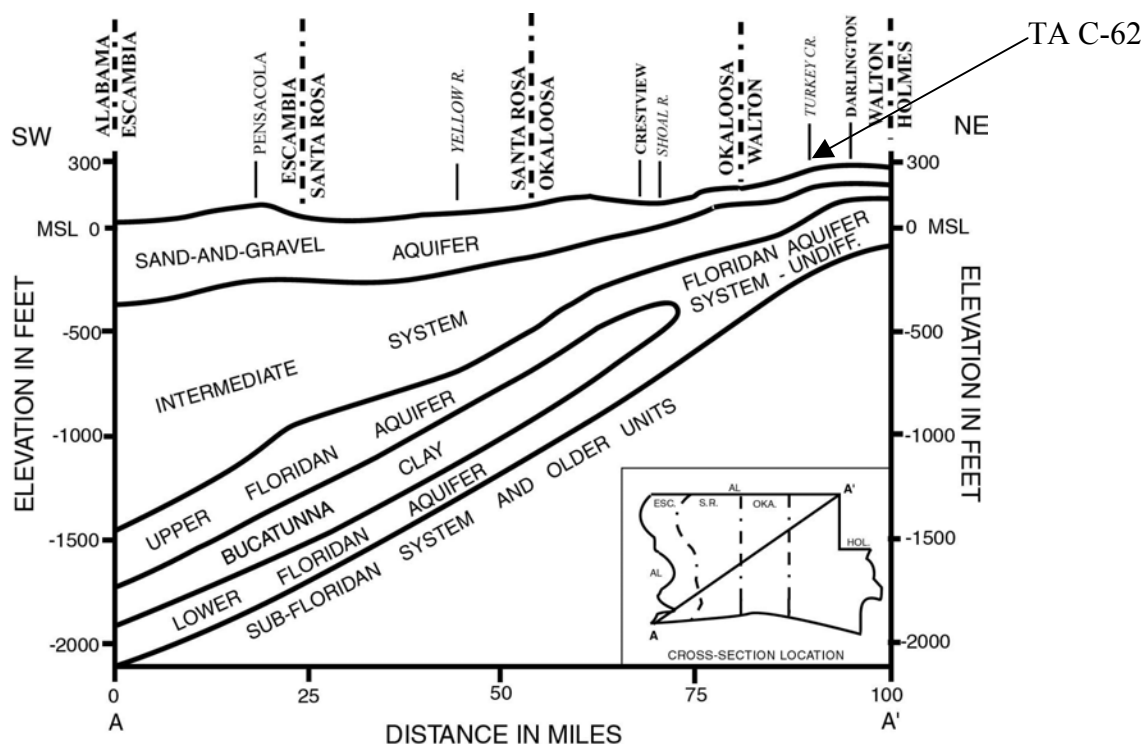
The northwest Florida aquifers associated with C-62 are divided into four hydrostratigraphic units. In descending order from the surface these units are the:

- Surficial Aquifer
- Intermediate System
- Floridan Aquifer
- SubFloridan System

The Surficial Aquifer (SA) and Floridan Aquifer (FA) move and store substantial amounts of water because of their medium to high permeability, whereas the Intermediate and SubFloridan Systems are primary confining units of the aquifer system that have low permeability. A cross-section of the aquifer system is shown at a regional scale in Figure 3-10.

### *Surficial Aquifer*

The Surficial Aquifer, also referred to as the Sand-and-Gravel Aquifer, consists of the Citronelle formation and marine terrace deposits that are contiguous with the land surface. As illustrated in Figure 3-10, the SA is primarily comprised of clean, fine-to-coarse sand and gravel, some silt and silty clay, and sparse amounts of peat (U.S. Air Force, 1995). The sand and gravel components allow water to percolate through the SA with relative ease. The thickness of the SA ranges from less than 50 feet in eastern Walton and central Okaloosa County to greater than 500 feet in western Escambia County.



**Figure 3-10. Cross-Section of the Geohydrology of Northwest Florida**

Ryan et al., 1998

Water exists in mainly unconfined conditions (water table) in the upper portion of the aquifer and semiconfined conditions (under pressure) in the lower portion of the aquifer. Rainfall is the primary contributor to SA recharge; a small amount of recharge from the FA occurs in areas where the FA is higher than the SA system. Conversely, the SA may act as a recharge source in areas where the SA is higher than the FA system. Recharge of the SA in Okaloosa County averages 20 inches/year and about 890 million gallons/day (Vecchioli et al., 1990). Eglin uses small amounts of water from the SA for landscape irrigation; however, the FA is used extensively (U.S. Air Force, 1995).

The SA system is in direct contact with surface waters such as streams and wetlands. Because of the confining nature of the underlying Intermediate System, recharge of the SA tends to flow laterally in a down gradient direction towards the entrenched valleys and steephead slope stream systems that are characteristic of Eglin. Discharge of groundwater constitutes the baseflow for most area rivers and streams (SAIC, 1999).

The position of the SA near the surface and above the confining Intermediate System and its relatively high percolation rates make the SA vulnerable to contamination by surface pollutants. Lateral migration of contaminants towards surface water discharge points potentially facilitates the transfer of groundwater pollutants to area streams, rivers, and wetlands.



### *Intermediate System*

The Intermediate System (IS) lies below the SA and is comprised of fine-grained clastic, clayey limestone, and shell sediments (Figure 3-10). The Pensacola Clay layer of the IS is the primary confining unit and restricts water movement from the SA above and the FA below. This thick, low-permeability formation serves as a confining unit that hydrologically isolates these two aquifers. The estimated leakance of the clay formation (vertical hydraulic conductivity in feet per day divided by thickness in feet) for Eglin is estimated to be  $10^{-6}$ /day to  $10^{-8}$ /day (Barr, 1981).

### *Floridan Aquifer*

The Floridan Aquifer (FA), which underlies the Intermediate System (Figure 3-10) and the entire state of Florida, is one of the most productive sources of water in the United States, providing water for public, industry, agriculture, and rural uses. In the panhandle, the surface of the FA ranges from more than 100 feet above mean sea level (MSL) to 1,450 feet below MSL, with the portion of the aquifer containing fresh water being approximately 2,000 feet thick (Katz, 1992). The FA is comprised of interbedded carbonate and dolomitic limestone sediments of varying permeability and the Bucatunna Clay confining unit (Figure 3-10). Because of the Bucatunna Clay unit, the FA is divided into the Upper and Lower Floridan Aquifers. Generally, the undifferentiated portion of the FA lies east of the Okaloosa-Walton County boundary, with the Pensacola Clay confining unit overlaying the FA west of the boundary (SAIC, 1999).

The surface of the Upper Floridan Aquifer (UFA) ranges from MSL in Okaloosa County to 1,250 feet below MSL in Santa Rosa County, with a thickness ranging from 25 to 400 feet. The top of the UFA below TA C-62 is approximately 150 feet below MSL. Groundwater storage and movement occurs in interconnected, intergranular pore spaces, small solution fissures, and larger solution channels and cavities. The UFA is the primary source of potable water for Okaloosa County and portions of Santa Rosa County (SAIC, 1999). The water quality of the UFA is suitable for most uses. Water pH ranges between 7.5 and 8.5, and water temperature varies between 18° C and 26° C. Hardness is normally below 150 mg/L, but can range up to 280 mg/L (U.S. Air Force, 1995).

The Lower Floridan Aquifer (LFA) exists in the western portion of the panhandle and is created by the confining Bucatunna Clay unit. The surface elevation of the LFA ranges from 200 to 1,900 feet below MSL, with thicknesses varying between 125 and 400 feet. The water of the LFA is not used as a major water supply because it is mostly saline and highly mineralized (SAIC, 1999). Chloride concentrations range between a norm of less than 10 mg/L to 25 to 75 mg/L in coastal areas. In the eastern part of Choctawhatchee Bay, chloride concentrations exceed 500 mg/L (U.S. Air Force, 1995).

### *SubFloridan System*

The SubFloridan System (SFS) is a confining unit below the Floridan Aquifer system comprised of clays, shale, chinks, limestone, and sandstone. The use of the SFS as a water source is limited since its hydraulic conductivity and productivity is less than the FA. The use of the SFS as a water supply is limited to Jackson and Holmes counties.

### ***Water Wells***

Water well ER-1621 is a limited use water supply located on the north end of the test area (Figure 3-3). The chlorine-treated water is used for mission testing purposes in addition to domestic uses. The water from the approximately 620-foot deep well is reported to smell like rotten eggs (U.S. Army Corps of Engineers, 1994).

### **3.2.4 Meteorology**

Generally, Eglin experiences a mild, subtropical climate as a consequence of its latitude (30° to 31°) and the stabilizing effects of the Gulf of Mexico and inland bays. The climate is characterized by warm, humid summers and mild winters, prevailing southerly winds, and intense thunderstorm events and hurricane cycles (U.S. Air Force, 1995). The Gulf of Mexico and the relatively shallow Choctawhatchee Bay (36 feet maximum), numerous marshes and swamps add moisture to the air and moderate winter and summer temperatures (Wolfe et al., 1988).

### **Temperature and Rainfall**

The proximity of these water bodies coupled with terrain that slopes from sea level to 266 feet 15 miles northeast creates a dominant summer weather phenomena known as the *Crestview Line* (so named because of its proximity to the town of Crestview, Florida). This weather formation creates a line of showers and thunderstorms parallel to the coast 10 to 25 miles inland based on the strength of the Gulf sea breezes. During peak summer periods, rainfall may occur almost daily. The effects of this weather phenomenon are also observed to a lesser extent throughout the year. Thunderstorms during the warmer months normally last from two to three hours (Brano, 1994). Hurricanes are additional weather events that have had a pronounced impact on the landscape.

For the baseline period, the mean annual temperature was 68 °F with temperatures equal to or below 32 °F on an average of 18 days and equal or above 90 °F on an average of 50 days. The mean annual precipitation was 61.8 inches. Thunderstorms occurred on an average of 80 days and measurable amounts of precipitation occurred on an average of 106 days. Mean annual wind speed was 5 knots and the prevailing surface wind directions were northerly with calm winds occurring 18.9 percent of the time (Brano, 1994).

The two peak rainfall periods are the primary period June through August and the secondary period February through April. Although the area experiences large amounts of rainfall, extensive droughts occur (Wolfe et al., 1988). A monthly weather summary for the baseline period is presented in Table 3-1.

### **Winds**

Prevailing winds are usually from the south in summer and the north in winter. Warm westerly winds originate from the Gulf of Mexico during the summer providing cooling on-shore breezes along the coast. The Gulf of Mexico moderates extremes in winter temperatures by providing heat in the winter. Winds from the northwest bring frontal systems of low precipitation and long

duration in the winter. The lowest average velocity winds occur in August and the windiest month is March.

For northwest Florida, daytime mixing heights are higher than for most of the continental United States. Average morning mixing heights for northwest Florida range from 1,650 to 3,300 feet above ground level (AGL) in the summer to 1,650 to 2,300 feet AGL in the winter. Average afternoon mixing heights are from 2,650 to 3,300 feet AGL in the winter to 4,600 to 5,250 feet AGL in the summer. Measurements of wind speed for 1995 through 1996 at Eglin Main showed a monthly average ranging from 6 to 9 knots.

**Table 3-1. Monthly Summary of Eglin AFB Baseline Climatic Data**

Month	Temperature (Mean °F)	Precipitation (Mean Inches)	Comments
January	51	4.2	Coldest month; polar fronts passed on average every 4 to 5 days; severe thunderstorms rare
February	54	4.5	Similar to January
March	60	6.0	Transitional warming and rainfall trend between winter and spring particularly towards the end of the month; squall lines ahead of polar fronts produce severe afternoon thunderstorms
April	67	4.5	Warmer temperatures and general decrease in frontal passage precipitation; Crestview line showers active as sea breeze fronts push inland
May	74	3.6	Normally the driest spring month; beginning of long warm to hot, humid season; Crestview line showers active as sea breeze fronts push inland
June	80	5.4	Warm and humid; scattered afternoon thunderstorms
July	82	8.0	Wettest month; intermittent scattered thunderstorms as southern maritime sea breezes move inland; beginning of tropical storm and hurricane season
August	82	6.9	Warm, wet, and humid; intermittent scattered thunderstorms as southern maritime sea breezes move inland
September	78	6.6	Transition between hot, humid summer and fall; sea breeze related precipitation gives way to frontal passage storms; increase in tropical storm and hurricane potential
October	69	3.5	Driest month; cooler with occasional weak frontal system storms; decline in tropical storm and hurricane potentials
November	60	3.8	Cooler, drier air; weak frontal passage storms; end of tropical storm and hurricane season
December	54	4.6	Polar fronts pass on average of every 4 to 5 days with associated moderate rainfall; severe thunderstorms rare

Source: Brano, 1994

## Inversions

Almost every morning, ground-based inversions occur at the base and break during the morning with surface heating. When the air temperature increases with height at a rate such that the air remains very stable and little mixing of the air occurs, there is an inversion. Ground-based inversions occur due to radiative cooling at the ground. For approximately five to seven days in the winter, the inversion does not break up due to a deep layer of sea fog that slows surface heating. Low wind speeds in these situations are typical (U.S. Air Force 1995).

### 3.3 BIOLOGICAL RESOURCES

This section describes the vegetation and wildlife resources that comprise the biological component of the TA C-62 landscape. Emphasis is placed on identifying sensitive habitats and species that are within federal and/or state mandates or are of special concern. A classification system of ecological associations has been developed based on flora, fauna, and geophysical characteristics. These ecological associations are described in the *Integrated Natural Resources Draft Transitional Plan*, Eglin AFB, 1998-2000 (U.S. Air Force, 1998) and the *Environmental Baseline Study - Resource Appendices* (U.S. Air Force, 1995).

#### 3.3.1 Ecological Associations

The southern mixed hardwoods, mixed hardwood swamps, bayheads, sand pine scrub, sandhills, pine flatwoods, cypress heads, and grassland/shrublands are the major forest community types on Eglin AFB. The first three are climax communities and the other four are successional. With improvements in drainage, elimination of fire, or mechanical management, succession may proceed in a variety of directions. Of these community types, only the Grassland/Shrubland ecological association is found within TA C-62. The interstitial areas surrounding the test area are part of the Sandhills ecological association.

##### Grassland/Shrubland

The Grassland/Shrubland association is a product of vegetation control and management. This association occurs in disturbed, open areas of the Sandhill association and is inclusive of TA C-62 (Figure 3-11). Mowing and roller drum chopping are used to remove and prevent reestablishment of tall vegetation. Terrestrial vegetation on TA C-62 is dominated by native grasses such as switchgrass (*Panicum Virgatum*), broomsedge (*Andropogon virginicus*), big bluestem (*Andropogon gerardii* var. *gerardii*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*) and various forbs. Woody vegetation is dominated by shrubs such as yaupon (*Ilex vomitoria*), holly (*Ilex opaca*), gallberry (*Ilex glabra*), sparkleberry (*Vaccinium arboreum*), gopher apple (*Licania michauxii*), dwarf huckleberry (*Gaylussacia dumosa*), sumac (*Rhus* spp.), and saw palmetto (*Serenoa punicea*) and hardwood trees including persimmon (*Diospyros virginiana*), live oak (*Quercus virginiana*), turkey oak (*Quercus laevis*), sand post oak (*Quercus margaretta*), and bluejack oak (*Quercus incana*).

##### Pine Sandhills

The majority of forests that occur on the Eglin reservation were once part of the longleaf pine (*Pinus palustris*) belt that extended from Virginia to Texas. It previously covered approximately 24 million hectares but presently occupies about 1.5 million hectares. Most large remnants (approximately 33 percent) are now in public ownership (Carter et al., 1997). Over the extent of its total presettlement range in the southeast, the Longleaf Pine-Wiregrass associations have been reduced by as much as 98 percent (Noss, 1989). The general locations of Pine Sandhills and pine production areas near TA C-62 are shown in Figure 3-11.

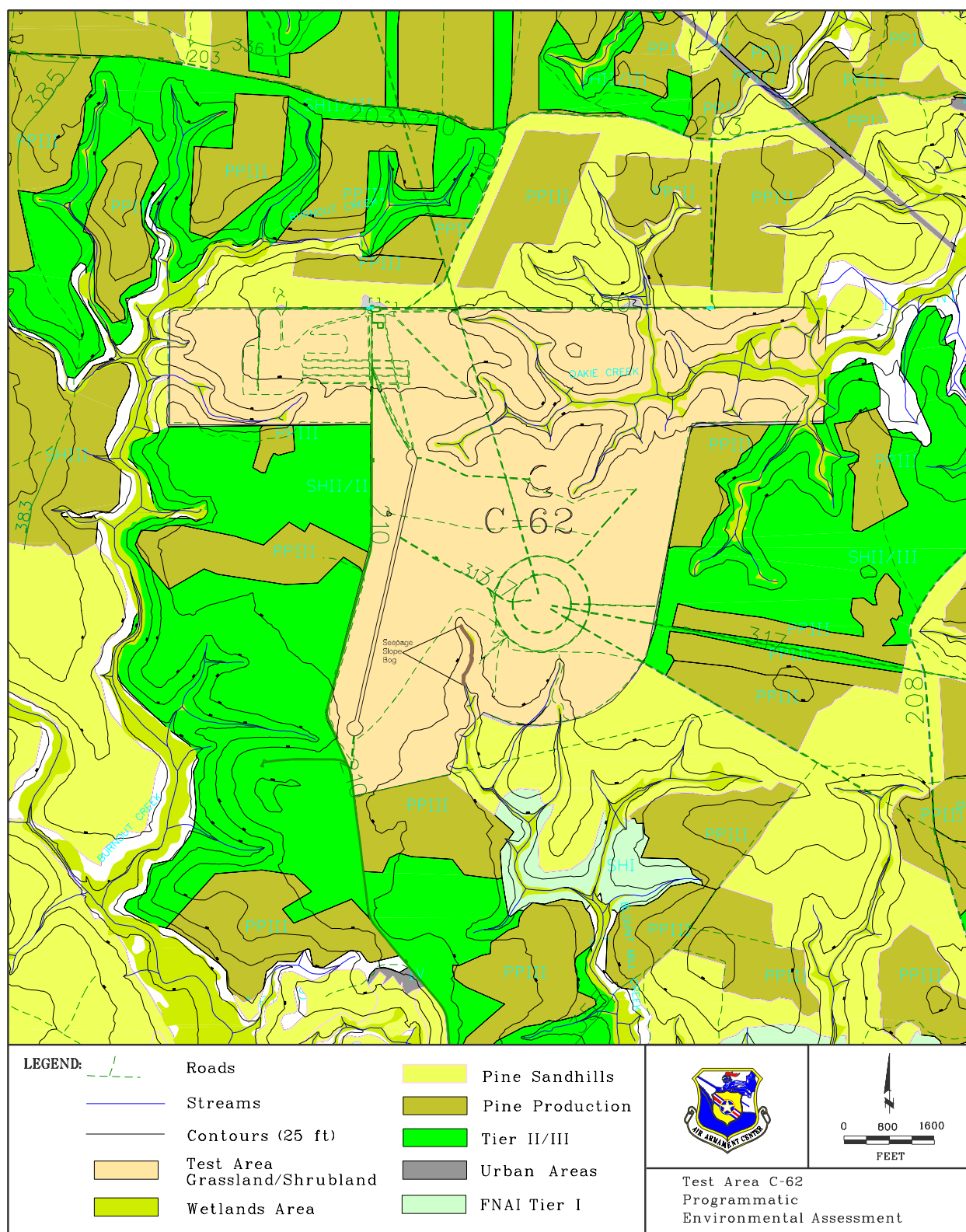


Figure 3-11. Botanical Features of TA C-62

Over time there have been numerous shifts in the relative dominance of pine and hardwoods on the Eglin landscape. These prehistoric shifts have been influenced by changes in climate and sea levels that altered soil moisture regimes and fire frequency. One of the most far-reaching impacts to pine ecosystems has been the suppression of fire. Historically, fire climax vegetation was maintained by fires caused by lightning, Native Americans burning to increase forage and aid in hunting, and Europeans burning to increase cattle forage. In the absence of fire, the fire climax longleaf pine communities typically succeed to a hammock dominated by oaks and other hardwoods (Landers and Boyer, 1999).

### ***Sandhills***

The Sandhills land type covers approximately 78 percent of the Eglin reservation and is generally characterized as rolling sandhill ridges dissected by streams. Generally, slopes vary from moderately steep along streams to relative flat in proximity to wet depressions. Steephead slopes are located at the headwaters of many Sandhill streams. The overall condition of the Sandhills varies from natural relatively undisturbed to substantially modified. Small amounts of scrub, hammock, flatwoods, dome swamp, depression marsh, and bottomland hardwood communities are interspersed with the Sandhills.

The Sandhills typically occur on deep, sandy Lakeland soils characterized by relatively flat to steeply sloped ridges, hilltops, gently rolling hills, and stream terraces. Loamy sands, sandy loams, loamy clay, and muck soils are found in lower lying areas. The relatively dry soil moisture environment created by the sandy soils is accentuated by the absence of a closed longleaf pine overstory canopy. Sunlight readily penetrates the scattered overstory, which warms the ground during the day, increases the rate of cooling at night, and reduces air moisture retention. Generally, these fluctuations in temperature and humidity are greater in the Sandhills compared to a closed canopy forest association.

The sandy soils make the Sandhills important to aquifer recharge by allowing water to quickly infiltrate the surface with little runoff and evaporation. The unique geomorphology and influences of climate have collectively structured Sandhills associations on Eglin that may be best described as a desert in the rain (Wolfe et al., 1988).

### ***Longleaf Pine Sandhills***

The Longleaf Pine Sandhills (LPS) are generally described as a forest of widely spaced overstory of longleaf pines, a sparse midstory of oaks and other hardwoods, and a dense understory of grasses, forbs, and ferns on rolling hills of sand. The LPS is a fire climax community that is dependent on frequent fire events to restrict hardwood competition and promote the dominance of longleaf pines and grasses such as wiregrass (*Aristida stricta*). Large-scale reduction in fire regimes has resulted in dramatic declines in this plant community. Without frequent fires every two to five years, the LPS generally succeeds to a hammock dominated by scrub oaks (*Quercus* spp.), live oaks (*Quercus virginiana*), and southern magnolia (*Magnolia grandiflora*).

The LPS community is primarily comprised of a midstory of xerophytic hardwood trees such as southern magnolia, sweetbay (*Magnolia virginiana*), live oak, persimmon (*Diospyros virginiana*), sparkleberry (*Vaccinium arboreum*), winged sumac (*Rhus copallinum*), and scrub

oaks, including turkey oak (*Quercus laevis*), bluejack oak (*Quercus incana*), and sand post oak (*Quercus margaretta*).

Although tree species diversity is relatively low, there is a wide variety of understory herbaceous plants such as wiregrass, Indiangrass (*Sorghastrum nutans*), wild buckwheat (*Eriogonum tomentosum*), beggars' tick (*Bidens mitis*), partridge pea (*Chamaecrista fasciculata*), yellow foxglove (*Agalinis* spp.), milk pea (*Galactia* spp.), queen's delight (*Stillingia sylvatica*), bracken fern (*Pteridium aquilinum*), dollarweeds (*Rhynchosia reniformis*), wild indigo (*Indigofera spicata*), gopher apple (*Licania michauxii*), golden-aster (*Chrysopsis* spp.), and other plants that provide fairly complete ground cover.

### ***Present Condition***

The Eglin LPS communities have undergone extensive alteration by reforestation measures and slash and sand pine plantings. Approximately 57,000 acres have been removed to create test areas and administrative and residential areas. Of the remaining 245,000 acres, almost half is severely cutover and dominated by scrub oaks. Between 1950 and 1990, over 69,000 acres were planted to longleaf, slash, and sand pine. Within the last 10 years, the herbicide Velpar has been applied to 9,300 acres of naturally seeded longleaf pine to release the pine from hardwood competition. Results were varied because of differences in application techniques and rates (U.S. Air Force, 1998c).

### ***Current Management Direction***

Ecosystem management is the operating philosophy of the AFB Natural Resources for the stewardship of Eglin's lands and resources to achieve environmentally sensitive, socially responsible, economically feasible, and scientifically sound multiple-use management of forest ecosystems. An Integrated Natural Resources Management Plan is being developed by Natural Resources to provide long-term interdisciplinary direction in the long-term management of Eglin's natural resources. The primary goal is to restore Eglin LPS plant communities that reflect to the degree possible natural species diversity, dominance, and distribution. The objective for achieving this goal is to manage ecosystems in a manner that directs succession towards a desired condition of scattered longleaf overstory, sparse hardwood midstory, and dense ground cover dominated by wiregrass. Techniques for achieving this objective include:

- Reintroduction of frequent fires
- Natural regeneration and plantings methods
- Mechanical and chemical thinnings
- Reduction in the use of heavy impact reforestation methods
- Removal of stunted slash and sand pine plantations and replacement with longleaf pine
- Removal of encroaching sand pine (U.S. Air Force, 1998c)

## Sensitive Habitats

Sensitive habitats found on various test areas may include FNAI rare plant survey areas, FNAI tier vegetative communities, wetlands, and neotropical migrant habitats. The management of sensitive habitats on Eglin is the responsibility of the AAC/EMSN Natural Resources Division of the Environmental Management Directorate. The FNAI has documented the presence of exemplary natural communities and assessed the ecological quality of Eglin lands.

### *Longleaf Pine Sandhill Tier I Habitat*

An FNAI Tier I of ecological condition is designated for the headwaters of Blount Mill Creek 1,113 feet south of TA C-62 (Figure 3-11). Baygall creeks surround this high quality Sandhill association of longleaf pine (*Pinus palustris*) on three sides. Ground cover is dominated by wiregrass (*Aristida stricta*). FNAI has designated a portion of Oakie Creek adjacent to TA C-62 as high quality upland mixed forest with high species diversity (Figure 3-11). A Tier I is defined as vegetation communities that are in, or closely approximate, a natural, undisturbed condition (FNAI, 1994). This Tier I habitat is considered by Eglin AFB Natural Resources Division to be a high quality area that should be given extra attention and protection as few remain throughout the range of longleaf pine (U.S. Air Force, 2001a).

Several Tier II communities are adjacent to the western and eastern boundaries of TA C-62 (Figure 3-11). Tier II reflects vegetative communities that have experienced moderate levels of disturbance but still retain good representation of species typical of the undisturbed state (FNAI, 1994). Neotropical migrant habitats include forested areas of the Sandhills as well as wetland habitats near the creeks.

### *Baygall Wetlands*

Baygalls are highly variable wetland communities comprised of broadleaved evergreen trees and shrubs and occur within Eglin steepheads, flatwoods, and blackwater stream margins. This type of wetland generally occurs as a densely forested, acidic wetland dependent on a continuous seepage flow or high water table. Fourteen species of rare plants have been documented to occur in Eglin baygall systems. Baygalls are fire maintained systems that require periodic fire, otherwise woody species increase shade and decrease available moisture, which influences the occupancy of other species. Fire is also instrumental in maintaining system-specific moisture regimes and evapotranspiration rates (FNAI, 1995; Litt et al., 2000).

Several sensitive wildlife species utilize baygall habitats including the state listed Florida bog frog (*Rana okaloosa*) and federally threatened eastern indigo snake (*Drymarchon corais couperi*). The small, shallow, slow-flowing groundwater seepage rivulets that characterize baygalls provide ideal egg-laying habitat for the bog frog. The relatively constant, shallow, low-flow conditions also provide areas for larvae development. Indigo snakes may use baygall type wetland habitats from August through November.

Baygall type wetlands occur on TA C-62 within the narrow floodplains of Oakie Creek and headwaters of Burnout Creek and Blount Mill Creek. These wetlands are characterized by a dense overstory of evergreen shrubs and an herbaceous understory and are maintained by



groundwater seepage and rainfall runoff. Activities that may affect wetlands (protected by the Clean Water Act) go through a permit process with the state as well as with the U.S. Army Corps of Engineers (ACE). Activities minimizing impacts to wetlands are preferred and the planning process should reduce or minimize ground-disturbing projects or actions occurring in a wetland.

### ***Blount Mill Creek Seepage Slope Bog***

One of the most rare, unique, diverse assemblages of plants and particularly carnivorous plants in the world occurs within the seepage slopes of the southeastern United States. These seepage slopes are generally confined to the Lower Gulf Coast Plain from the Apalachicola River in the east to the Tangipahoa River in the west and up to 100 kilometers inland. Pitcher plant diversity and abundance are highest within the seepage slopes of the Florida Panhandle. While more than 100 plant species have been identified in these environments, the plant species diversity in Panhandle seepage slopes has been as high as 300 species, which makes Panhandle seepage slope bogs one of the single most rare and unique ecosystems in the world (Wolfe et al., 1988).

Eglin seepage slopes are primarily associated with the clayey soils of the upland Pine Sandhills in the northeastern portion of the reservation. The seepage slope is a unique and high priority natural community on Eglin. The Eglin AFB Natural Resources Division has identified the protection of seepage slopes as an Eglin Conservation target; it ranks fourth in order of importance on the list of communities (U.S. Air Force, 2001a).

A seepage slope bog or pitcher plant bog is a small, grass/sedge/forb dominated wetland occurring along a gentle slope intersection of the horizontal water table over a broad area. Seepage slopes primarily form in Eocene to Holocene age materials along hillsides or in bowl shaped depressions. They occur on slopes with constant seepage from a perched water table where the ground is saturated but rarely inundated. Subsurface clay layers restrict downward percolation and create lateral groundwater flows that emerge at mid to lower slope positions and create saturated soil conditions. The water produced by hillside seeps flow gently downslope over the surface. Seepage slopes communities normally occur on slopes of less than 20 percent and in some instances the slope is barely discernable with the human eye.

Although defined as wetlands, seepage slope bogs can experience soil moisture gradient extremes. During periods of wet weather, seepage is normally continuous, which keeps the soil saturated; however, during droughts the soil may become quite dry. Typically, soils are nutrient poor, acidic, loamy sands with high organic content. The organic layers that accumulate on the surface vary from a few inches to several feet thick. Seepage slopes are characterized by high acidic pH that generally ranges from 3.5 to 5.0. Species that persist in seepage slope habitats have adaptations to low nutrient soils and drastic changes in soil moisture that give them a competitive edge over other species. Seepage slopes frequently contain a diversity of wetland plants including a number of carnivorous species such as pitcher plants (Wolfe et al., 1988; Studenroth, 1994).

The primary threat to the existence of seepage slopes is loss of habitat due to anthropogenic soil disturbances, fire suppression and ecological succession, plant collecting, and introgressive hybridization. Direct disturbance of seepage slope bog soils or inundation by sediment can alter hydrology enough to cause a shift in dominant vegetation. Fire exclusion causes the

encroachment of shrubs that shade out diverse forbs causing an eventual shift to a baygall community. Feral hogs are particularly destructive within seepage slopes, which are used as wallows. They uproot vegetation, creating barren patches that limit the spread of fire in these systems. It is estimated that **97 percent** of the Gulf Coast's seepage slopes have already been lost (Studenroth, 1994).

A seepage slope bog wetland has been identified on the western headwater stream slope segment of Blount Mill Creek in the southern portion of TA C-62 (Figure 3-11). A botanical survey of the area was performed in August 2001. Plant samples were collected during the survey. The seepage slope is most prevalent at the headwaters of Blount Mill Creek and becomes more restricted in size as the stream begins to channelize (Figures 3-12 and 3-13). At some locations, upslope erosion has covered seepage slope areas and encroached into the stream, threatening the viability of this unique, high quality wetland ecosystem (Figure 3-14). Several state listed plant species were identified during the botanical survey (Figure 3-15). A report detailing the components and characteristics of this seepage slope bog are presented in Appendix E. Because of varying seasonal growth and flowering characteristics, additional sensitive species may be identified during surveys at other times of the year.



**Figure 3-12. Saturated seepage bog soils and typical herbaceous ground cover**



**Figure 3-13. Area of open seepage water flow**



**Figure 3-14. Gully erosion sediments are encroaching onto seepage slope areas altering hydrology and vegetation**



**Figure 3-15. State listed seepage slope bog red flowered pitcher plant**

## Sensitive Plants

No sensitive plant species have been identified as occurring within the terrestrial Grassland/Shrubland habitats of TA C-62. State listed threatened wetland plant species identified on the Blount Mill Creek seepage slope bog during the botanical survey include:

- Red flowered pitcher plant (*Sarracenia rubra*)
- Water sundew (*Drosera intermedia*)

There are several species of *Xyris* at the site, one of which may be a state listed species. Additional consultations with botanical experts would be required to identify individual *Xyris* species collected. A comprehensive list of identified species is presented in Appendix E. Including the species identified during the August 2001 botanical survey, there are 14 plant species that are listed by the State of Florida as threatened or endangered that could also occur on unsurveyed western portions of Burnout Creek and unnamed stream segment of Oakie Creek. These state listed species are presented in Table 3-2 and illustrated in Figure 3-16. Identification of state sensitive plants on the test area may require species consultation.

## State Listed Species Consultations

Special incidental take permits and relocation permits may be granted from the Florida Fish and Wildlife Conservation Commission (FWCC) for state listed species only if the “taking” does not prove detrimental to the survival potential of the species. The accidental killing of a species of special concern should be documented and reported to the FWCC. The killing or wounding of an endangered species is punishable as a second-degree misdemeanor under State of Florida Laws and Regulations, Wildlife Code (Chapter 39, Florida Administrative Code) (Wood, 1996). Considerations are given to identifying if state listed species may be affected and assessing potential impacts (U.S. Air Force, 2001d).

**Table 3-2. State Listed Plant Species Potentially Associated with TA C-62 Habitats**

Sensitive Species	Habitat
<b>Endangered State Species</b>	
Hummingbird Flower ( <i>Macranthera flammea</i> )	Seepage slope, seepage stream bank, and floodplains
Panhandle Lilly ( <i>Lilium iridollae</i> )	Black mucky soils and peaty sands, on savannas and borders of shrub-bogs, on the banks of blackwater creeks and baygalls, flatwoods
Sweet Shrub ( <i>Calycanthus floridus</i> )	Stream banks, floodplains
Yellow Fringeless Orchid ( <i>Platanthera integra</i> )	Seepage slope, wet prairie, and mesic flatwoods
<b>Threatened State Species</b>	
Decumbant Pitcher Plant ( <i>Sarracenia purpurea</i> )	Bogs
Florida Anise ( <i>Illicium floridanum</i> )	Seepage stream bank, seepage slope, baygall
Heartleaf ( <i>Hexastylis arifolia</i> )	Seepage stream banks
Mountain Laurel ( <i>Kalmia latifolia</i> )	Seepage stream banks
Large Leaved Jointweed ( <i>Polygonella macrophylla</i> )	Scrub, sand pine/oak scrub ridges
Parrot Pitcher Plant ( <i>Sarracenia psittacina</i> )	Seepage slope, wet prairie, and wet flatwoods
Pineland Wild Indigo ( <i>Baptisia calycosa</i> var <i>villosa</i> )	Sandhills/Sand Pine with an open canopy and sandy soils
Red Flowered Pitcher Plant ( <i>Sarracenia rubra</i> )	Favors clear, swift-flowing streams, although it is also found in acid bogs and depressions of the flatwoods, wet prairies, and baygalls
Yellow Butterwort ( <i>Pinguicula lutea</i> )	Bogs and flatwoods
Yellow Fringed Orchid ( <i>Platanthera ciliaris</i> )	Bogs and flatwoods

Source: U.S. Air Force, 1995





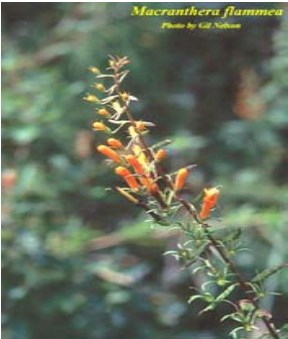
Red Flowered Pitcher Plant



Yellow Butterwort



Mountain Laurel



Hummingbird Flower



Parrot Pitcher Plant



Yellow Fringed Orchid



Panhandle Lily



Sweet Shrub



Florida Anise

Figure 3-16. Sensitive Plant Species

### 3.3.2 Wildlife

Eglin supports a rich diversity of game and nongame wildlife due to the variety of habitats found on the base. Approximately 559 animal species have been identified, 35 of which are sensitive animal species (U.S. Air Force, 1995). Eglin has managed its wildlife since 1949; the current wildlife management plan is incorporated into the *Integrated Natural Resources Draft Transitional Plan* (U.S. Air Force, 1998). The Sikes Act provides a mechanism for the management of wildlife on military reservations and extends protection to migrating game birds. In 1991, the Air Force signed a Memorandum of Agreement to participate in the U.S. Fish and Wildlife Service's Federal Neotropical Migratory Bird Conservation Program, which promotes and protects neotropical birds and their habitats (U.S. Air Force, 1995).

#### Wildlife Habitats

The characterizations provided below are not comprehensive or exclusive listings since the species utilize a variety of communities (U.S. Air Force, 1995).

##### *Grassland/Shrubland*

Representative reptiles present in the clearings and grasslands include a pit viper, the eastern diamondback rattlesnake, eastern coachwhip and southern black racer snakes, gopher tortoise, eastern box turtle, and slender glass lizard. Gopher tortoises are part of a habitat that includes the sensitive indigo snake and gopher frog as well as several other species (U.S. Air Force, 1995). The southern pocket gopher, cotton mouse, oldfield mouse, feral hogs and eastern cottontail rabbit are present in clearings and other similar habitats.

Raptors include the screech owl, red-shouldered hawk, and the great horned owl, which forage over the open areas (U.S. Air Force, 1995). The southeastern American kestrel preys on birds and small rodents, reptiles, and insects in the clearings.

##### *Sandhills*

The barking treefrog and central newt are representative amphibians of the Sandhills ecological association. Leopard frogs are found in swales containing wetlands. The gopher frogs utilize ephemeral ponds, including depression marshes for breeding along with some sandhill upland lakes (provided there are no fish present). They also wander in the surrounding upland areas. Reptiles include the gray rat snake, coral snake, six-lined racerunner, the eastern fence lizard, gopher tortoise, and box turtle.

Several types of squirrels (the fox, gray, and flying), armadillo, and feral pig also live in the Sandhills along with the white-tailed deer and raccoon. Characteristic predators include the gray fox and bobcat. The Florida black bear is occasionally found in the Sandhills ecological association. Poaching of these animals has occurred (U.S. Air Force, 1995).

Raptors include the screech owl, red-shouldered hawk, southeastern American kestrel, and great horned owl, which nest and hunt rodents in the woodlands of the Sandhills (U.S. Air Force, 1995). Ground-dwelling game birds include wild turkeys, wood ducks, bobwhite quail and mourning doves. The sandhill upland lakes provide feeding areas for wading birds. Other

indigenous birds include warblers, vireos, the red-cockaded woodpecker, the pileated woodpecker, the white-breasted nuthatch, the Bachman's sparrow, and the pine siskin (bird).

The high quality sandhills within the Sandhill ecological association are important habitat for the many neotropical migrants. These are birds that winter in South and Central America and come to temperate regions, such as the continental United States, to breed in the summer. Neotropical migrants occurring on Eglin include the ruby-throated hummingbird, summer tanager, common yellowthroat, blue grosbeak, and great crested flycatcher. A two-year study on neotropical migrants present at Eglin indicates that riparian areas and bottomland hardwood swamps associated with major drainages provide the most important habitat for neotropical migrants (U.S. Air Force, 1995).

The Blount Mill Creek Sandhill south of TA C-62 contains uneven distribution of longleaf pines and dense sapling growth. Other Sandhills in the area are of rather low quality and exhibit sand pine encroachment (FNAI, 1994).

### Sensitive Wildlife Species

Air Force projects that may affect federally protected species and candidate species for federal listing and critical habitat for protected species are subject to Sections 7 and 10 of the Endangered Species Act prior to the irreversible or irretrievable commitment of these resources (U.S. Air Force, 1995). Eglin has developed an overall goal within *the Integrated Natural Resources Draft Transitional Plan* (U.S. Air Force, 1998) to continue to protect and maintain populations of native threatened and endangered plant and animal species within the guidelines of ecosystem management. In 1992, Eglin, along with the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission, entered into a cooperative agreement to manage individual species on the installation, including both federal- and state-listed species.

Sensitive species include those with federal endangered or threatened status, federal candidate species, and state endangered, threatened, and species of special concern status (U.S. Air Force, 1995). An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become endangered within the future throughout all or a significant portion of its range due to loss of habitat, anthropogenic effects, or other causes. Federal candidate species and state species of concern are those that should be given consideration during planning of projects, but have no protection under the Endangered Species Act.

The three sensitive wildlife species listed as federally and/or state endangered, threatened or species that merit consideration that have been identified as occurring within and/or adjacent to the Grassland/Shrubland habitats on TA C-62 include:

- Southeastern American kestrel (*Falco sparverius paulus*)
- Gopher tortoise (*Gopherus polyphemus*)
- Florida burrowing owl (*Speotyto cunicularia floridana*)

The four additional federal- and/or state-listed wildlife species that have been identified as occurring within one kilometer or potentially visiting TA C-62 include:

- Red-cockaded woodpecker (*Picoides borealis*)
- Florida black bear (*Ursus americanus floridanus*)
- Eastern indigo snake (*Drymarchon corais couperi*)
- Florida pine snake (*Pituophis melanoleucus*)

These species and their state status and habitats are presented in Table 3-3, illustrated in Figure 3-17, and discussed in the following narrative.

**Table 3-3. Federal- and State-Listed Wildlife Species that Occur or May Occur within One Kilometer of TA C-62**

Sensitive Species	Habitat
<b><i>Federally-Listed Endangered Species</i></b>	
Red-cockaded Woodpecker	Longleaf pine forests over most of Eglin AFB. RCW densities are high near ranges due to the beneficial effect of range fires controlling the underbrush in these areas.
<b><i>Federally-Listed Threatened Species</i></b>	
Eastern Indigo Snake	Occurs in Sandhills and is a frequent user of gopher tortoise burrows and stumpholes.
<b><i>State-Listed Threatened Species</i></b>	
Red-cockaded Woodpecker	Longleaf pine forests over most of Eglin AFB. RCW densities are high near ranges due to the beneficial effect of range fires controlling the underbrush in these areas.
Florida Black Bear	Utilizes riparian areas and may pass through the test area.
Eastern Indigo Snake	Occurs in Sandhills and is a frequent user of gopher tortoise burrows and stumpholes.
Southeastern American Kestrel	Preys on animals in clearings and woodland edges.
<b><i>State-Listed Species of Special Concern</i></b>	
Gopher Tortoise	Primarily found in longleaf pine and xerophytic oak woodlands and open grasslands of the test areas.
Burrowing Owl	Occupies grassland burrows created by other animals.
Florida Pine Snake	Retreats to loosely packed sand, rodent burrows, and occasionally gopher tortoise burrows.

Source: U.S. Air Force, 1995; U.S. Air Force, 1998

### ***Southeastern American Kestrel***

The southeastern American kestrel subspecies has been extirpated over most of its former range and the current range is not described in the literature (Loftin, 1992). The former breeding range extended from Louisiana, Mississippi, central Alabama, and southern Georgia to southern Florida. Their former winter range extended from their breeding range south to the Gulf coast of Louisiana to Key West, Florida (American Ornithologists Union, 1957).

The southeastern American kestrel is a small raptor that preys upon insects during the summer and also feeds on small rodents, birds, and reptiles that are common in open grasslands (Figure 3-17). Over 30 species of birds and about 30 species of mammals are listed as prey (Mueller, 1987). Generally it lays its eggs in early to mid-April (Bent, 1962). The birds search for prey from high perches along the forest edge or hover over open areas with short, sparse vegetation (DeGraff et al., 1991).

The kestrels occupy nearly all Grassland/Shrubland, Sandhills, and other forested community types. Habitat requirements include an adequate prey base, perch sites, and nesting sites. They mostly inhabit open forests and clearing edges with snags. The thick understory and midstory in Sandhills communities that are cut or are not burned may have an adverse effect on kestrel populations. Prescribed burning can be beneficial since it enhances habitat and increases the prey base (Hoffman and Collopy, 1988). The Sandhills association is a preferred habitat in Florida with the pine-oak woodlands providing quality nesting and foraging sites (Bohall-Wood and Collopy, 1986). During a nesting survey, kestrel densities were higher in Sandhill Longleaf Pine-Scrub Oak than in hardwood hammock communities (Hoffman and Collopy, 1988).

The decline in breeding pairs is correlated to a decrease in scattered, mature pine trees and snags in open habitats. Populations in north-central Florida have been reduced primarily due to logging operations. Since the 1940s, the population of southeastern American kestrels has decreased by 80 percent because of the reductions in longleaf pine flatwoods that once dominated the north-central Florida area (Smallwood and Collopy, 1993).

Nests are normally located along the forest edge and may be used for several years. The kestrels prefer to nest in snags and tight-fitting live tree cavities created by other birds (DeGraff et al., 1991). The birds most frequently locate their nests in abandoned red-cockaded woodpecker and other woodpecker holes in longleaf pines 12 to 35 feet above the ground. Natural cavities and snags in turkey oaks and live oaks may also be used as nesting sites (Hoffman and Collopy, 1987). The kestrels are quite tolerant of human activity around their nests. They are frequently flushed or caught at the nest without desertion. In Ohio, kestrels use centers of human activity more than other raptors (Fischer et al., 1984).

No kestrel sighting have been reported for TA C-62; however, the test area perimeter of overstory pines and understory hardwoods provides ideal prey bases, perch sites, and nest sites. The large expanse of the maintained, pasture-like condition of the test area offers a preferred setting from which the small raptor can hunt rodents, reptiles, and other birds. There have been numerous sighting of the kestral throughout the Eglin Reservation

### ***Gopher Tortoise***

The gopher tortoise is found primarily within the longleaf pines of the Sandhills, as well as the sand pine scrub and live oak hammocks of the Sand Pine and Grassland/Shrubland associations (U.S. Air Force, 1995). During a 1994 survey of 832 acres of TA C-62, 291 gopher tortoise burrows were identified. The survey was initiated in response to a proposed Smoke Week exercise with the purpose being to determine if eastern indigo snakes were on the test area. Documented observations and known locations of gopher tortoise burrows are listed in Table 3-4 and depicted in Figure 3-18.





**Eastern Indigo Snake (Kenneth L. Krysko)**



**Florida Pine Snake (Barry Mansell)**



**Gopher Tortoise (Marianne Cowley)**



**Eglin Florida Black Bear (USAF)**



**Red-cockaded Woodpecker (USFW)**



**Florida Burrowing Owl (USFW)**



**Southeastern American Kestrel (USFW)**

**Figure 3-17. Sensitive Wildlife Species**

**Table 3-4. 1994 TA C-62 Gopher Tortoise Burrow Survey**

Active	Inactive	Possibly Occupied	Status Unknown
106	81	72	32

Fourteen of the survey burrows were observed to be collapsed with tire tracks across the collapsed entrances of three burrows.

The life of the gopher tortoise revolves around a burrow constructed by digging with its shovel-like feet (Figure 3-17). The burrows are frequently constructed in areas with low-growing plants, and sandy, well-drained soils in open, sunny areas with bare patches of ground. Gopher tortoise burrows are essential to the ecosystem of dry, sandy uplands. These burrows not only provide shelter for the gopher tortoise, but also for many other species of animals including such sensitive species as the indigo snake, pine snake, and gopher frog.

In the sandy soils of TA C-62, the self-excavated gopher tortoise burrows are estimated to be between 14 to 20 feet long and 6 to 18 feet below the surface. Most burrows are straight and unbranched and have an enlarged chamber at the end. The burrows remain at fairly constant temperature and humidity throughout the year, acting as a refuge from cold, heat, and dryness. They also act as a refuge from periodic fires that occur in this dry habitat.

The tortoise primarily eats grasses, leaves, fruits, seeds, and insects. The foods most frequently found in their diets are grasses (*Poaceae* spp.) and legume fruits (*Fabaceae* spp.). Female tortoises lay 3 to 15 eggs in the sand in front of their burrows during late April and May. These eggs incubate for up to 100 days. Predators such as raccoons, coyotes, and snakes, destroy more than 80 percent of gopher tortoise nests, resulting in a very low hatching success rate (Pucket and Franz, 1991).

A 1989 report indicated 60 vertebrate and 302 invertebrate species had been recorded in gopher tortoise burrows. On Eglin, dusky gopher frogs and eastern indigo snakes use this critical habitat for cover. The gopher tortoise is found in pine and oak woodlands in the Sandhills ecological association, but can also be found in the Sand Pine and Grassland/Shrubland associations. Many inactive burrows are found on Eglin; the number of active burrows is considerably less. The rising number of inactive burrows has lead to concerns about a population decline of the species due to poaching and loss of fire-dependent habitat (U. S. Air Force, 1995).

Many associate species use or are dependent on tortoise burrows for seasonal or year-round dens, daytime retreats, nesting sites, food sources, and/or escape cover (Wilson and Mushinsky, 1997). Associate tortoise burrow species also exhibit preferences for active or inactive burrows (Lips, 1991). Although the gopher tortoise is primarily found within the longleaf pines of the Sandhills on Eglin, they also seem to have a strong affinity for open, dry, uplands of many test areas. Test area vegetation maintenance promotes the growth of preferred grass and forb food sources and high sunlight penetration, which is needed to attain minimum thermal requirements for daily activities (Mushinsky and McCoy, 1994). One tortoise may maintain 2 to 3 burrows within its home range.

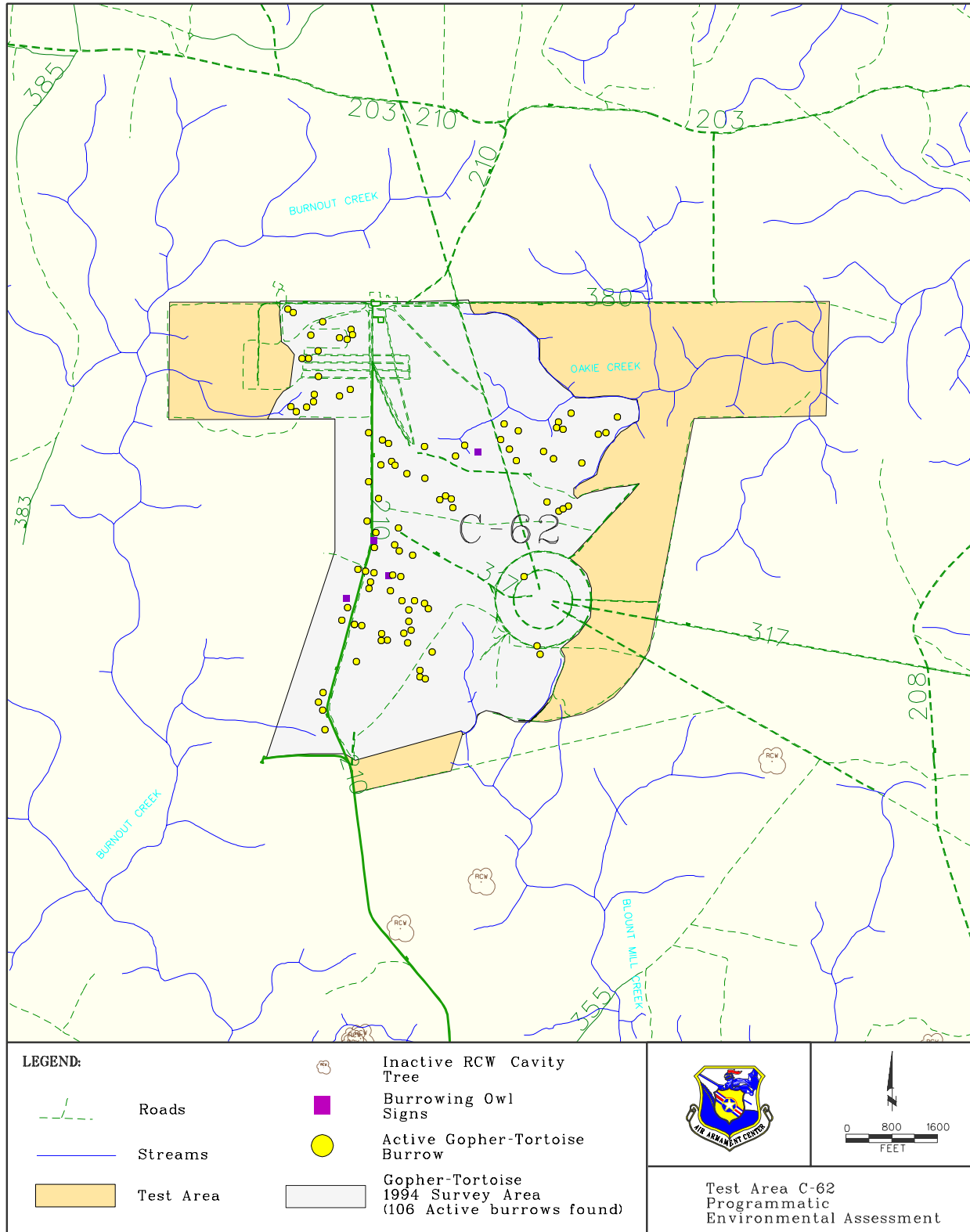


Figure 3-18. Wildlife Features of TA C-62



Active as well as abandoned gopher tortoise burrows serve as important habitat for the eastern indigo snake. At Fort Stewart, Georgia, eastern indigo snakes were often observed at abandoned tortoise burrows (Williamson and Moulis, 1979), whereas Speake et al. (1978) found that of 108 burrow/retreat sites identified as habitat for indigo snakes, 77 percent were in active tortoise burrows. Therefore, activities such as roller drum chopping that destroy and degrade tortoise burrow habitat can also negatively impact indigo snake populations.

### ***Florida Burrowing Owl***

The Florida burrowing owl is a small, long-legged, brown owl that occurs on high sandy ground with little growth, particularly prairies, Sandhills, and pastures (Figure 3-17). During the 1994 TA C-62 gopher tortoise survey, burrowing owl signs were observed around three burrows. An owl was identified at a burrow along the headwaters of Oakie Creek (Figure 3-18). The owls usually live in colonies and breed, nest, and brood in the burrows excavated by other animals.

The owls will often evict raccoons, snakes, and gopher tortoises to acquire desired burrows or, in some cases, they may dig their own burrows in loose sandy soils. A burrow with low, open cover that provides good horizontal visibility is preferred (Figure 3-19). Typically, a burrow will range from two to three meters long and less than one meter below the surface. The owls spend considerable portions of the day perched at the burrow entrance or atop the mound of soil surrounding it and are easily approached (Kale, 1978).



**Figure 3-19. Owl Burrow**

Arthropods, mainly insects, comprise the majority of the owls' diet. Small rodents and other birds are frequent prey. Nesting begins as early as November and continues to May. Factors in population decline include loss of burrow and foraging habitats and creation of suboptimal nesting habitat. It has been suggested that human activities such as mowing have had a beneficial effect on the Florida burrowing owl population (Ligon, 1963). A burrowing owl and owl burrow were identified during the 1994 TA C-62 gopher tortoise survey and more recently a burrowing owl was sighted in flight on the test area during a July 2001 field investigation.

### ***Red-cockaded Woodpecker***

The red-cockaded woodpecker (RCW) was federally listed as endangered under the Endangered Species Act in 1970 (35 Federal Register 16047) and 1973. By the time of listing, the species had declined to fewer than 10,000 individuals due to an almost complete loss of habitat. The RCWs that inhabit the forested areas of Eglin comprise the fourth largest remaining species population in the United States (Figure 3-17). In the following section, RCW biology and life requisites, current status, management emphasis area, and project area clusters are discussed.

### ***Biology and Life Requisites***

These nonmigratory, territorial nongame birds live in clusters that are most frequently found in relatively open (60 to 90 square feet basal area per acre), park-like stands of longleaf pine with

sparse hardwood midstories and encompass an average of 10 acres (Lennartz, 1988 and Hooper et al., 1980). The RCW is a keystone species of fire-dependent pine ecosystems in the South and is the primary species to excavate cavities in an otherwise cavity-free environment. On average it takes RCWs 6.3 years to excavate a nest cavity in longleaf pines (Conner et al., 1997). The size of foraging habitat is dependent on the quality of the habitat; clans may forage over several hundred acres where habitat conditions are not ideal (Hooper et al., 1980).

A two-year study conducted by Hardesty et al. (1997) of RCW groups on Eglin AFB identified important relationships among RCW home ranges size, habitat structure and composition, and RCW demography. Findings relating the linkage between RCW population health and ecosystem processes on Eglin AFB included:

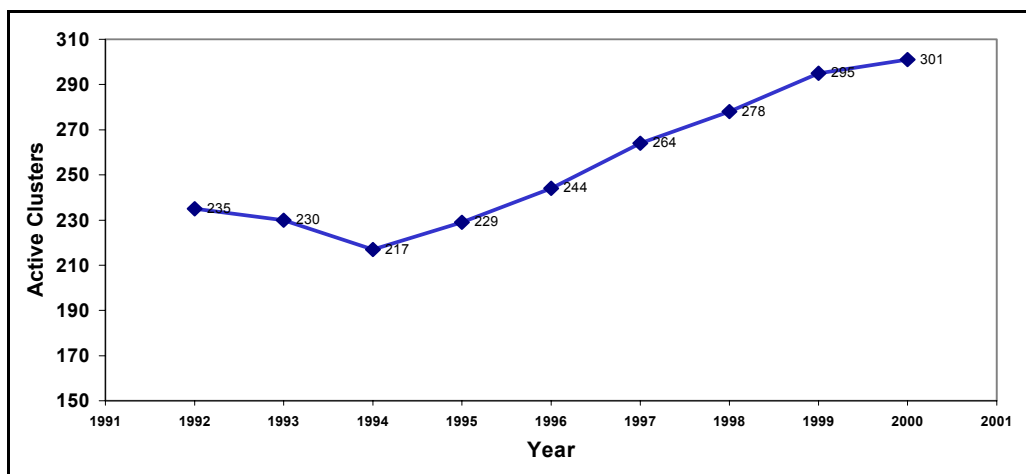
- Compared to other studies of RCW foraging substrates in the southeast (Hooper and Harlow, 1986; Porter and Labisky, 1986; and Hooper and Lennartz, 1981) the RCWs on Eglin AFB showed a preference for both larger ( $\geq 49.2$  feet high and  $\geq 10$  inch diameter at breast height [dbh]) and older ( $\geq 150$  years) longleaf pine trees as a foraging substrate. RCWs avoided smaller class trees and, when given a choice, chose larger and older trees, which suggests that the availability of larger and older trees is a potential indicator of foraging habitat quality.
- RCWs were observed foraging on dead or dying pines more often than they were observed foraging on hardwoods. This suggests that dead and dying trees may be an important foraging resource.
- The home ranges of reproductively successful groups were on average 46 percent larger than that of unsuccessful groups. Year to year variations in home range size suggest that while habitat may have some year to year influence on home range size, other variables such as weather, prey abundance, or group size may be more influential. Extraterritorial areas shared by more than one group were also identified.
- RCW post-breeding mean home range size was estimated to be 264 acres. Study results provided partial support of the hypothesis that RCW home range size was inversely correlated to the density of the surrounding RCW population. This suggests that the current population density may be less than can be sustained by existing habitat. Generally, populations with relatively low densities are more prone to population declines.
- Habitat fragmentation resulting from military test areas in concert with population densities may constrain the size of RCW home ranges. Study results suggest that within the vicinity of current RCW groups there may be relatively little undesirable foraging habitat.
- Significant variation in RCW productivity was explained by increased forb cover (35 percent of variation), decreased hardwood height (28 percent), decreased hardwood dbh (26 percent), and lower densities of pines  $\geq 49.2$  inch dbh (22 percent).

Threats to RCW species viability are based on the lack of suitable habitat. Principle factors that could limit suitable nesting habitat and potential RCW breeding groups include fire suppression and lack of cavity trees. Additionally habitat fragmentation and subsequent cluster isolation could also limit the number of breeding groups (U.S. Fish and Wildlife Service, 2000).

### Current Status

As of July 2000, there was an estimated 12,500 RCWs living in roughly 5,000 family groups across 12 states (U.S. Fish and Wildlife Service, 2000). Approximately 95 percent of suitable RCW habitats on Eglin have been surveyed for the presence of cavity trees. Of the 6,663 cavity trees located, 1,161 were determined to be active. The number of active clusters has grown from 217 in year 1994 to 301 in year 2000 (Figure 3-20).

Since 1995, 31 birds have been moved as part of an intra-population translocation program. All birds were moved to high intensity treatment plots within the Eglin eastern sub-population. Between 1995 and 1999, plots with translocation grew 5 percent more than plots without translocation.



**Figure 3-20. Eglin RCW Population Trend**

Currently, 61 clusters (58 percent of recruitment clusters) are occupied with a high percentage either initially captured or occupied by solitary males. Most of the population increase is attributed to occupation of artificial cavity sites. The current number of breeding pairs ranges from 256 using all monitoring data to 281 using only random sample clusters to extrapolate the number of pairs. Since year 1994, 656 artificial cavities or cavity starts have been drilled to provide 105 recruitment clusters.

The Eglin western sub-population is stable to increasing with maintenance and the Eglin eastern sub-population of 53 groups would be considered stabilized with the addition of 47 groups (total of 100). The eastern sub-population increased by 20 to 25 percent in five years; however, translocation was relatively ineffective in specific clusters (U.S. Air Force, personal communication, 2000a).

### Management Emphasis

The RCW Management Emphasis Area (MEA) encompassing Sandhills and Wetlands ecological associations within the Eglin reservation has been divided into five management units ranging from 4,000 to 80,000 acres in size that represent two present and three former RCW subpopulations. The purpose of the MEA is to focus and prioritize short- and long-term

ecosystem management activities in a manner that will stabilize and expand Eglin's RCW population. The RCW is an indicator species of a high quality Sandhills ecosystem.

The Eglin LPS community has undergone extensive alteration by reforestation measures and slash and sand pine plantings. Approximately 57,000 acres have been cleared to create test areas and administrative and residential areas. Of the remaining 245,000 acres, almost half is severely cutover and dominated by scrub oaks. Between 1950 and 1990, over 69,000 acres were planted to longleaf, slash, and sand pine.

The desired future condition is to maintain and/or improve habitat for RCW. The primary goal is to restore LPS plant communities to a condition that best reflects natural species diversity, dominance, and distribution. The objective for achieving this goal is to manage ecosystems in a manner that directs succession towards a desired condition of scattered longleaf overstory, sparse hardwood midstory, and dense ground cover dominated by wiregrass and other native grasses and forbs. Techniques for achieving this objective include:

- Reintroduction of frequent fires
- Natural regeneration and plantings methods
- Mechanical and chemical thinnings
- Reduction in the use of heavy impact reforestation methods
- Removal of stunted slash pine, sand pine plantations and encroaching sand pine, and replacement with longleaf pine (U.S. Air Force, 1998)
- Control of invasive species

A high quality LPS community (Tier I) typically contains multiple age-classes of pines showing a wide range of dbh classes and regeneration stages including old growth (100+ years) or older mature (50+ years) native pine trees forming an open canopy.

No active RCW nest trees have been recorded within the TA C-62 boundaries; the closest active cluster of active RCWs is 3,283 feet to the west of the test area. Inactive RCW nest trees are within 2,000 feet of the southern boundary of the test area. Based on Eglin Natural Resources Division RCW plans, the closest recruitment cluster (artificial cavities, relocations, etc.) would be approximately 2,200 feet to the south of the test area; however, it may or may not be done because of its juxtaposition to other active clusters. There are no plans to build up RCW populations near TA C-62, but natural migration into the LPS habitats such as the Tier I habitat south of the test area could occur (U.S. Air Force, personal communication, 2001).

### ***Florida Black Bear***

The bear population on Eglin is Florida's fifth largest population of the subspecies (Figure 3-17). The exact locations of the bears are sensitive information because of the threat of poaching. Stratman (1998) studied the Eglin bear populations for four years to determine seasonal feeding habitats and preferred habitat and the effects of controlled burning and other human activities. The study results are presented in Table 3-5.

**Table 3-5. Summary of a Four-Year Study of Eglin Air Force Base Black Bears**

Topic	Results
<b>Diet</b>	<ul style="list-style-type: none"> <li>• Spring: Dominated by saw palmetto hearts, beetles, and yellow jackets.</li> <li>• Early Summer: Blueberries comprised 44% of diet.</li> <li>• Late Summer: Sweet gallberry, acorns, and black gum.</li> <li>• Fall: Saw palmetto selected over acorns.</li> </ul>
<b>Habitat</b>	<ul style="list-style-type: none"> <li>• Riparian Zones: This habitat type ranked highest among habitats, seasonally and annually. Preference for riparian habitats is hypothesized to be related to their distribution and vegetational structure; abundant food sources are readily available throughout the year and the riparian corridors allow bears to travel great distances while remaining close to escape cover.</li> <li>• Swamps: This habitat type ranked second as a preferred habitat with heaviest use occurring during the fall for denning.</li> <li>• Pine Sandhills: Use of pineland habitats during the summer corresponded with the availability of blueberry and huckleberry food sources. Sandhills are also used during the fall season as a source of acorns.</li> <li>• Open areas ranked lowest amongst all habitat types not because of military missions but because of the lack of forest cover. It was hypothesized that Eglin bears have likely acclimated to mission activities.</li> </ul>
<b>Fire</b>	<ul style="list-style-type: none"> <li>• Use of burned lands was highest for areas burned on 6- and 2-year cycles. Use of burned areas was associated with proximity to riparian zones and high soft mast production.</li> </ul>

Source: Stratman, 1998

During winter the bears may hibernate in tree cavities, under logs and rocks, in banks, caves, or culverts and in shallow depressions (Hamilton and Marchinton, 1980). Black bears eat a variety of foods relying most heavily on grasses, herbs, fruits, and mast. They also feed on carrion and insects (Jonkel, 1978).

The key habitat requirements of black bears are food, water, cover, and denning sites, spatially arranged across sufficiently large, relatively remote blocks of land. Remoteness is an important spatial feature of black bear habitat. This is generally accepted as a contiguous forested tract of more than 2,500 acres or a tract with .5 kilometer or less of road per square kilometer (Pelton, 1986). The home ranges of the black bear vary with habitat types, sex and age, season, environmental conditions, and population density, while providing the essentials for food, water, cover, space, denning sites, and contacts with potential mates. Home ranges vary from 4,150 to 105,700 acres for males and 1,360 to 26,000 acres for females (Hellgren and Vaughan, 1989).

Bears are adaptable and opportunistic. They can survive in proximity to humans if afforded areas of retreat that ensure little chance of close contact or visual encounters with humans. Heavy understory such as canebrakes (*Arundinaria gigantea*) and palmetto (*Sabal minor*) are examples of such escape cover. High-quality cover for bedding and escape is of great importance as forests become smaller and more fragmented and as human encroachment and disturbance of bear habitat increases (Rogers and Allen, 1987). Travel corridors may facilitate bear movements through highly fragmented forest habitats (Noss, 1987). The primary threat to bear populations is the destruction, modification, and/or fragmentation of its habitat/home range.



No bears are reported to have been sighted on TA C-62. The test area wetlands associated with Oakie Creek are ranked high as potential bear habitat. A potential limiting factor to bear use of the area is the absence of a riparian hardwood overstory. Bear movement through the test area would likely be limited to seasonal feeding in the wetlands or movement between habitats.

### *Eastern Indigo Snake*

The eastern indigo snake was granted protection by the State of Florida in 1971 and federally listed as threatened in 1978 (Federal Register Vol. 43, No. 52:11082 – 11093). The overall range of *Drymarchon corais* extends from the southeastern United States coastal plain to northern Argentina. Only the subspecies eastern indigo (*Drymarchon corais couperi*) and Texas indigo (*Drymarchon corais erebennus*) occur within the United States.

### *Biology and Life Requisites*

The eastern indigo snake is the largest nonvenomous snake in North America and can grow up to 125 inches in length (Figure 3-17). The snake is carnivorous and will eat any animal up to about the size of a squirrel. It frequents mesic flatwoods, hammocks, bottoms, canebrakes, thickets, and xeric areas with deep, well drained to excessively drained, sandy soils. The summer home range for a single male has been reported to be as large as 470 acres (Moler, 1985). The snake is an upper level, active, diurnal predator that often feeds along the edge of wetlands on a variety of vertebrates including fish, frogs, lizards, small turtles, and other snakes (Hallam et al., 1998).

Habitat preferences vary seasonally. Pine sandhill winter dens are used from December to April, summer territories are selected from May to July, and from August through November they are frequently located in shady creek bottoms. These seasonal changes in habitat encourage the maintenance of travel corridors that link these different habitat types (Hallam et al., 1998). Koshman (1978) listed the indigo snake as occupying seven out of eight terrestrial and five of eleven wetland habitats in Florida.

Indigo snakes are a commensal species associated with gopher tortoise (*Gopherus polyphemus*) burrows. They use burrows in winter and spring for egg-laying, shedding, and protection from dehydration and temperature extremes (Hallam et al., 1998). A study of radio-instrumented indigo snakes in Georgia found that the snakes selected Sandhills as winter habitat and 94 percent used tortoise burrows as winter dens (Landers and Buckner, 1981).

The upland LPS, creek bottoms of the unnamed stream and Crane Branch, and the bottomlands of the Yellow River floodplain provide suitable seasonal habitats for eastern indigo snakes. The existing section of RR 211 sited for obliteration is located in the transition between seasonal indigo snake habitats. Although gopher tortoise burrows were not identified during field investigations, burrows likely occur on the sandy uplands of the project area. The fire maintained LPS of the project area provides favorable habitat conditions for gopher tortoises.

*Current Status*

The Florida panhandle has a few known small populations of the eastern indigo snake, but it is generally considered rare in the region. The snake may be found in a variety of habitats on Eglin; however, sightings have been sparse (18 incidental sightings between 1974 and 1999). The closest indigo snake sighting is approximately four miles from the project site. The latest recorded sighting was a road-killed snake reported 30 January 1999 (U.S. Air Force, 2001b).

No eastern indigo snakes were sighted during the 1994 gopher tortoise burrow survey of TA C-62. However, with a relatively high density of gopher tortoise burrows and the proximity of upland and riparian habitats associated with the test area, indigo snakes may seasonally use these test area habitats. Surface disturbance activities such as TA C-62 test area maintenance roller drum chopping that destroy and degrade tortoise burrow habitats can also negatively impact eastern indigo snake populations.

*Management Emphasis*

As with the RCW, threats to eastern indigo snake species viability are primarily based on the lack of suitable habitat. Population declines are primarily linked to habitat loss, fragmentation, and degradation (Moler, 1985). Additional research is needed in the area of population monitoring methods, habitat requirements of juveniles, and captive breeding and restocking potentials. Although the Eglin Natural Resources Branch has not developed an eastern indigo snake management plan, their current LPS restoration and management programs are increasing the provision of suitable snake habitats.

The primary goal is to restore LPS plant communities to a condition that best reflects natural species diversity, dominance, and distribution. The objective for achieving this goal is to manage ecosystems in a manner that directs succession towards a desired condition of scattered longleaf overstory, sparse hardwood midstory, and dense ground cover dominated by wiregrass and other native grasses and forbs.

Techniques for achieving this objective include:

- Reintroduction of frequent fires
- Natural regeneration and plantings methods
- Mechanical and chemical thinnings
- Reduction in the use of heavy impact reforestation methods
- Removal of stunted slash pine, sand pine plantations and encroaching sand pine, and replacement with longleaf pine

A high quality LPS community (Tier I) typically contains multiple age-classes of pines showing a wide range of dbh classes and regeneration stages including old growth (100+ years) or older mature (50+ years) native pine trees forming an open canopy. High quality Tier I communities exhibit portions of vegetative associations that are in or closely approximate their natural state

(FNAI, 1994). A Tier I LPS community indicates a high quality site for federally listed threatened and endangered species.

### ***Florida Pine Snake***

The Florida pine snake is a large (to 8.3 feet), white, tan, and black serpent (Figure 3-17). The snake is typically found in Sandhill sandy soil areas occurring primarily in longleaf pine/turkey oak forests. Male and female snake home ranges have been reported to vary from 3 to 68 acres. The snakes primarily feed on small mammals, birds and their eggs, lizards, other snakes and their eggs, and insects. The snake has a pointed snout and enlarged rostral scale that allows it to easily burrow in loosely packed sandy soils for nesting, winter hibernation, and escape. Nests are excavated in exposed, unvegetated soft-packed soil with little or no organic matter to a depth of 9 to 12 inches. Nest clearings average 166 feet long and 260 feet wide on slopes of less than 14 degrees. As with the eastern indigo snake, the pine snakes are known to use active and inactive gopher tortoise burrows. As with other sensitive species, habitat loss and degradation is a primary reason for population declines of the snake (Jordon, 1998).

The Florida pine snake has not been documented to occur on TA C-62. The pine Sandhills that surround the test area provides suitable pine snake habitats.

### **Federal Listed Species Consultations**

Air Force projects that may affect federally protected species, species proposed for federal listing, and critical habitat for protected species are subject to Sections 7 and 10 of the Endangered Species Act prior to the irreversible or irretrievable commitment of these resources (U.S. Air Force, 1995). Eglin has developed an overall goal within the *Integrated Natural Resources Transitional Plan* to continue to protect and maintain populations of native threatened and endangered plant and animal species within the guidelines of ecosystem management (U.S. Air Force, 1998). In 1992, Eglin, along with the U.S. Fish and Wildlife Service (USFWS) and the State of Florida Fish and Wildlife Conservation Commission (FFWCC), entered into a cooperative agreement to manage individual species on the installation, including both federal- and state-listed species.

The Endangered Species Act (ESA) of 1973 as amended (16 USC § 1531) provides a means whereby the ecosystem upon which endangered species depend may be conserved. The U. S. Fish and Wildlife Service and National Marine Fisheries Service collectively survey the status of species and list those species determined to be threatened or endangered (16 USC § 1533). Once a species is listed, the statute prohibits harm to the species or its habitat (16 UCS § 1538). Listing decisions must be based on the best available scientific and commercial information regarding the species and the reasons the species is threatened with extinction [50 CFR § 424.11(b) (1992)]. However, the U. S. Fish and Wildlife Service and National Marine Fisheries Service is precluded from considering economic impact or other impact of listing.

Sensitive species include those with federal endangered or threatened status, federal candidate species, and state endangered, threatened, and species of special concern status (U.S. Air Force, 1995). The U. S. Fish and Wildlife Service and National Marine Fisheries Service lists species as either threatened or endangered. The term species includes species, subspecies, and isolated population groups of vertebrate species capable of interbreeding. Threatened species are species

likely to become endangered within the foreseeable future throughout all or a significant portion of their range [16 USC § 1532(20)]. Endangered species are species in danger of extinction throughout all or a significant portion of their range [16 USC § 1532(6)]. Federal candidate species and state species of concern are those that should be given consideration during planning of projects, but have no protection under the Endangered Species Act.

The U. S. Fish and Wildlife Service and National Marine Fisheries Service designation of critical habitat is intended to identify and protect habitat essential to the survival and recovery of listed species [50 CFR § 424.12(b)]. Critical habitat is the specific areas within and outside the geographical range of the species at the time of listing that are found to contain the physical or biological features essential to the conservation of the species and that may require special management or protection [50 CFR § 424.02(d)]. Areas may be excluded from designation as critical habitat if the costs of designation would outweigh the benefits, provided the exclusion would not result in extinction of a species [16 USC § 1533(b)(2)].

Section 7(a) requires the Department of Interior (DOI) to review and utilize its programs to further the purposes of the ESA, and all other federal agencies must in consultation with the DOI utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species [16 USC § 1536(a)(1)]. Federal agencies are required to consult with the U. S. Fish and Wildlife Service and/or National Marine Fisheries Service to ensure any federal action is not likely to adversely affect a listed species or designated critical habitat [16 USC § 1533(a)(2); 50 CFR § 402.01(a)]. Federal action includes all activities authorized, funded, or carried out, in whole or in part by federal agencies (50 CFR § 402.02). Under Section 7(d) of the ESA, no irretrievable or irreversible commitment of resources can be made during formal consultation that precludes reasonable alternatives [16 USC § 1536(d)]. Failure to observe this provision disqualifies the agency or applicant from appeal to the Endangered Species Committee.

Section 9 of the ESA prohibits unauthorized taking of listed species [16 USC § 1538(a)(1); 16 USC § 1538(a)(1)(B)]. Taking is broadly defined to include any activity that would or would attempt to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a species covered by the ESA. A take includes direct actions as well as indirect action that result in harm from habitat alteration, modification, or destruction [16 USC § 1532(19); 50 CFR § 17.3 (1993)]. The pursuing, molesting, harming, harassing, capturing, or possession of any endangered species or parts of their nests or eggs except as authorized by special permit are allowed only when the activity enhances the survival potential of the species.

Section 10 of the ESA authorizes issuance of an incidental take permit. The incidental take permit allows the applicant to avoid Section 9 liability for any taking that might occur incidental to and not the purpose of the carrying out an otherwise lawful activity [16 USC § 1539(a)(1)(B); 50 CFR § 17.3 (1993)]. An incidental take permit requires the submittal of a habitat conservation plan specifying the activities pursued and the measures to be taken by the applicant to mitigate any authorized take [16 USC § 1539(a)(2)(A); 50 CFR § 17.22(b)(1)].

### Feral Hogs

The feral hog (*Sus scrofa*) is a nonindigenous species that is descended from escaped domestic swine introduced by early settlers to the area (Figure 3-21). The Florida Natural Areas Inventory (FNAI) has associated increases in feral hog populations with damage to seepage slopes, wet flatwoods, baygalls, and wet prairie areas on Eglin (FNAI, 1994). Damage to seepage slopes and wet prairies have been particularly extensive.



Figure 3-21. Feral Hog

Based on field evidence, the seepage slope bog on Blount Mill Creek is used extensively by pigs. Hog rooting behaviors (digging and rooting for food) disturb the surface and create pockets that hold water (Figure 3-22). This type of disturbance can degrade wetland habitats and damage or destroy sensitive plant species.

Based on discussions with Eglin AFB Natural Resources Division wildlife biologists, it is estimated that the oily substance shown in Figure 3-22 is oil secreted from hog glands during feeding or wallowing. The pigs use depressions dug in the mud of wetland areas as wallows during the hot summer months.



Figure 3-22. Blount Mill Creek Seepage Slope Bog Feral Hog Damage

Eglin Natural Resources Division is in the process of planning a formalized hog control program through USDA wildlife services. This program would target hog control in areas where natural resources are being most damaged. Short of fencing the area off completely, eliminating hogs from a particular area is impossible (U.S. Air Force, 2001b).

### 3.4 ANTHROPOGENIC

This section describes Eglin's policy regarding cultural resources and identifies and describes the anthropogenic features associated with TA C-62. Recreation and public access are not a concern since these activities are not permitted on the test area because of the sensitivity and potential danger of munitions testing and training operations.

Humans inevitably create features on the landscape or exercise activities that have varying degrees of influence on the environment. This section identifies existing conditions or features that characterize historic and active human influence on the environment associated with TA C-62. Specifically, the following discussion documents:

- Cultural Resources
- Civil Engineering Explosive Ordnance Disposal Open Burn/Open Detonation (CE-EOD OB/OD) Operations
- Installation Restoration Program Areas of Concern (IRP/AOC)
- Unexploded Ordnance (UXO) and Debris
- Test Area Roads
- Erosion Impact Areas
- Test Area Vegetation Maintenance
- Test Area Target Maintenance
- Air Quality

### 3.4.1 Cultural Resources

Section 106 of the National Historic Preservation Act requires that federal agencies analyze the impacts of federal activities on historic properties. Areas potentially impacted by mission activities are surveyed as part of the Air Force Environmental Impact Analysis Process. Mitigative measures are developed to minimize impacts. Defining zones of constraint aids project planners and managers in decision-making for relocation of a project site to avoid delays necessitated by additional investigation and/or consultation. The following paragraphs describe Eglin's cultural resources as either 1) Areas of Cultural Resource Constraint, or 2) Constraint-Free Areas.

1. Areas of Cultural Resources Constraint - These areas require cultural resources investigation and/or consultation between Eglin and the State Historic Preservation Office (SHPO) during the planning stages of a project. Areas of constraint include, but are not limited to, previously unsurveyed property determined to have a high probability for the occurrence of cultural resources and significant historic properties. These areas are defined as one of the following:
  - a. 100-acre (or greater if warranted by site size) area around sites eligible or potentially eligible for the National Register of Historic Places
  - b. Non-surveyed areas within high or indeterminate probability zones. High probability zones are defined as 1) areas within 200 meters of water and situated no more than 50 feet above the water source, and 2) areas where the historic record indicates activity may have occurred prior to military ownership.
2. Constraint-Free Areas - These areas do not require cultural resources consideration or consultation prior to mission activity. Constraint-free areas include two subsets:
  - a. Surveyed areas (regardless of probability) with the exception of the buffer zones around eligible or potentially eligible sites (which fall into Category 1 above)
  - b. Non-surveyed low probability areas with the exception of buffer zones around eligible or potentially eligible sites (which fall into Category 1 above)

Figure 3-23 indicates areas potentially harboring cultural resources on TA C-62. While this is not a definitive planning tool, it is an adequate representation of area with the potential for the occurrence of cultural resources based on the “Areas of Cultural Resource Constraint” parameters outlined previously. The Cultural Resources Division of the Environmental Management Directorate, Air Armament Center (AAC/EMH) has inventoried approximately 120,000 acres of the Eglin Reservation, most of which falls within high probability areas.

Of the 463,000 acres comprising the Eglin Military Complex, 120,000 acres have been surveyed and over 1,500 cultural sites identified. A total of 213,000 acres has been removed from consideration because of the low probability of finding prehistoric cultural resources. It is estimated that there are approximately 200,000 acres of high probability area on Eglin. Less the number of acres already inventoried, there are roughly 80,000 acres remaining that comprise test areas as well as interstitial lands. Areas of constraint are systematically surveyed as part of Eglin's compliance requirements to inventory all of its cultural resources. As these are continuously being updated, consultation with AAC/EMH is required to obtain the latest information for any activities that would impact a constraint area.

Activities planned in constraint-free areas do not require consultation with the SHPO. However, activities planned in constraint-free areas should be coordinated with AAC/EMH to ensure that there would, in fact, be a low potential for the occurrence of cultural resources. In the event of unexpected discovery of cultural resources in areas shown to be constraint free, all activity in the immediate vicinity will cease until the Base Historic Preservation Officer has been notified and a determination of significance has been rendered. Eglin's Cultural Resources Division will work to ensure that discovery does not impede the mission.

AAC/EMH is currently integrating their maps into a Geographic Information System (GIS) to better describe definitive cultural resource areas. More specific information is sensitive and AAC/EMH should be consulted on a need-to-know basis. Until a complete survey of the constraint areas has been accomplished, the danger of direct physical impact to unknown cultural resources is a possibility.

Test Area C-62 contains large areas determined high probability for the occurrence of cultural resources. Although archaeological investigations are underway in zones identified as high probability, Eglin feels that safety concerns override the need to survey within boundaries of test areas that have the potential to contain unexploded ordnance or present other serious hazards. A formal assessment of all the test areas is planned by AAC/EMH personnel in consultation with the State Historic Preservation Officer to identify contaminated and hazardous areas and release them from Section 106 until such time as safety concerns are cleared. An approximate 2.22 acre prehistoric artifact scatter Deptford Cultural Period archaeological site (Site Number 8WL111) has been identified at the headwaters of Oakie Creek on TA C-62. The site was originally visited in the 1960s by Eglin personnel, and was revisited by archaeologists in 1982 in preparation for Eglin's Historic Preservation Plan. During the 1960s surface collection, aboriginal ceramic and lithic artifacts and marine shells were identified. During the 1982 surface collection, a single plain sherd and no Depthford or Swift Creek ceramics were collected. No artifacts were recovered from the excavation of two judgmentally placed shovel pits.

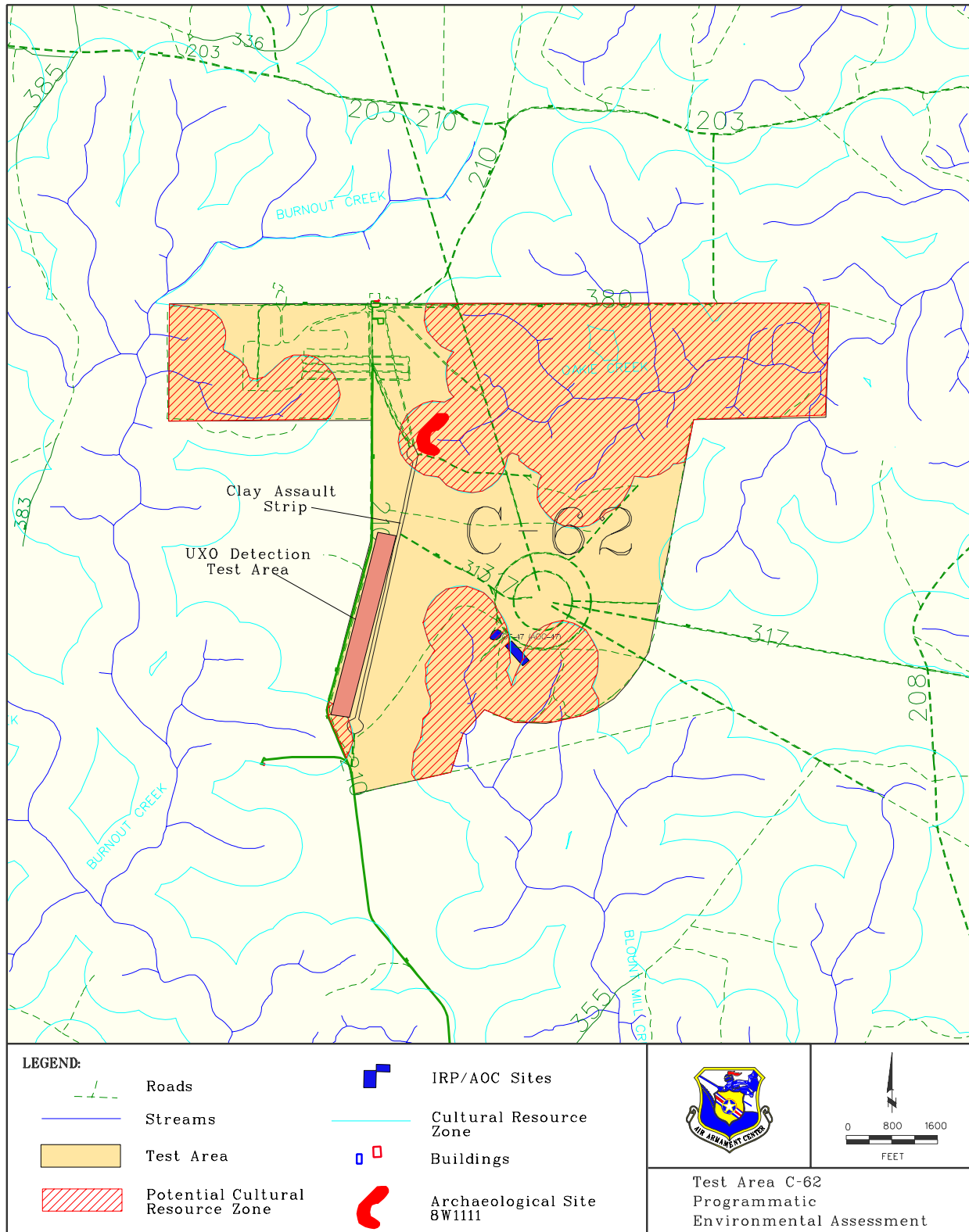


Figure 3-23. Anthropogenic and Cultural Features of TA C-62



Mr. David Pugh, an archaeologist for AAC/EMH, revisited the site on 14 November 2000. During the site survey, one piece of Weeden Island pottery (circa 600 to 1,100 A.D.) and one area of shell scatter composed of oyster shells were identified (Figure 3-24). It was observed that there was extensive erosion between the test area road, the site, and Oakie Creek, with military ordnance throughout the area (Figure 3-25). The site has suffered long-term soil erosion caused by roller drum chopping and improper road location and maintenance.

An unpaved target access road located at the perimeter of the archaeological site also borders the crest of a test area stream slope. The road has degraded to the point that it functions to collect and concentrate runoff and has formed several gullies along the stream slope, one of which has disturbed the archaeological site (Figures 3-23 to 3-25). It was determined that the site has been destroyed by erosion generated by mission activities and is no longer considered significant. It was also concluded that the presence of ordnance might make further excavations and artifact recovery unsafe.

The Burnout Creek headwater area along the northwestern portion of TA C-62 was investigated and produced nothing of cultural concern (U.S. Air Force, 2000a). Two prehistoric sites ineligible for inclusion in the National Register of Historic Places were identified during a survey of the Blount Mill Creek headwater area in the southern portion of the test area. Both sites were relatively undisturbed. Recovery included Swift Creek and bi-faced lithics. The sites are currently under review by the Florida State Historic Preservation Office (U.S. Air Force, 2001c).

### 3.4.2 CE-EOD OB/OD Operations

CE-EOD OB/OD operations are permitted on TA C-62 to destroy excess, obsolete, or unserviceable munitions, components, and energetic materials, as well as media contaminated with energetics. In OB operations, energetics and/or munitions are destroyed by self-sustained combustion ignited by an external source such as flame, heat, or detonatable wave. In OD operations, detonatable munitions are destroyed by a detonation generally ignited by the detonation of an energetic charge.

Munition disposal operations are normally conducted for units assigned to Eglin on a bimonthly basis. Special disposal operations may be scheduled to meet the needs of Eglin generators.



**Figure 3-24. Archaeological Site 8WL111  
Oyster Shell and Munitions Scatter Area**  
(David Pugh, 2000)



**Figure 3-25. Archaeological Site 8WL111  
Erosion** (David Pugh, 2000)

Military organizations outside Eglin that wish to use Eglin disposal facilities must have a current support agreement. CE-EOD munitions disposal operations on Eglin are limited to a maximum of 3,000 pounds combined explosive weight (NEW). Open detonations are conducted within permitted areas on TA C-52 and TA C-62 only. Open burn activities are only performed within the permitted area on TA C-62. On munitions disposal days CE-EOD is required to obtain a weather report from scene weather personnel to ensure that weather parameters are within the USEPA permit requirements - wind speed between 3 and 15 miles per hour and no inversion forecast. Operations do not proceed without the required weather parameters.

### **Open Burn Operations**

An open dumpster type kettle located within the permitted OB/OD site on TA C-62 has been used for an OB (Figure 3-26). During an open burn, the kettle is loaded with a minimum of 4 feet of dunnage. Munitions are then placed on top of the dunnage with a minimum freeboard of 12 inches. The kettle doors are closed and diesel fuel is poured over the dunnage and munitions; a maximum of 50 gallons of diesel can be used. The disposal package is ignited by a remote initiation system. Only one OB operation has been performed at TA C-62 because of the emissions generated by the burn event and extensive post operation cleanup requirements.

The current OB process has no provision for the addition of forced combustion air to ensure complete combustion and minimize emissions. The process emits considerable smoke and combustion products from the burning dunnage and burn items are frequently ejected from the burn kettle during the burn process. In response to the contamination potentials associated with existing methods, CE-EOD has identified and implemented the use of a new technology to improve OB operations efficiency and reduce environmental impact potentials. OBs can be initiated by electric, burning, or energetic charge ignition systems.

A private company has submitted an alternative open burn process proposal and prototype for testing by Eglin AFB CE-EOD. The proposed burn kettle is a Transportable Burn Kettle Processor (TBKP). Operation of the kettle is based on contained burn technology, which allows thermal treatment of energetic waste materials without uncontrolled release to the atmosphere (Figure 3-27).

The TBKP burn kettle provides for the containment of disposal items, metal shrapnel potentially produced, and most of the combustion generated particulate matter. The burn kettle is heated to 1000°F to ensure wastes are thermally destroyed. The unit is equipped with forced combustion air to ensure complete and consistent burn conditions and minimizes the production of emissions. Combustion gases pass through high efficiency filters and wet or dry scrubbers before being vented through a stack. Because there is no controlled flame device, contained burned facilities can be permitted as RCRA subpart X miscellaneous treatment units rather than as incinerators (Gabrielsen and Hayes, 2000).

The TBKP unit is mounted on a trailer, allowing the unit to be moved to the OB/OD permit area for use one to two days a month and then moved to an adjacent control building when not in use. Various energetic items are placed inside the unit and heated until the items cook off. This is beneficial since the OB/OD site is also used for the detonation of energetic materials and the test area is an active inert bombing range.

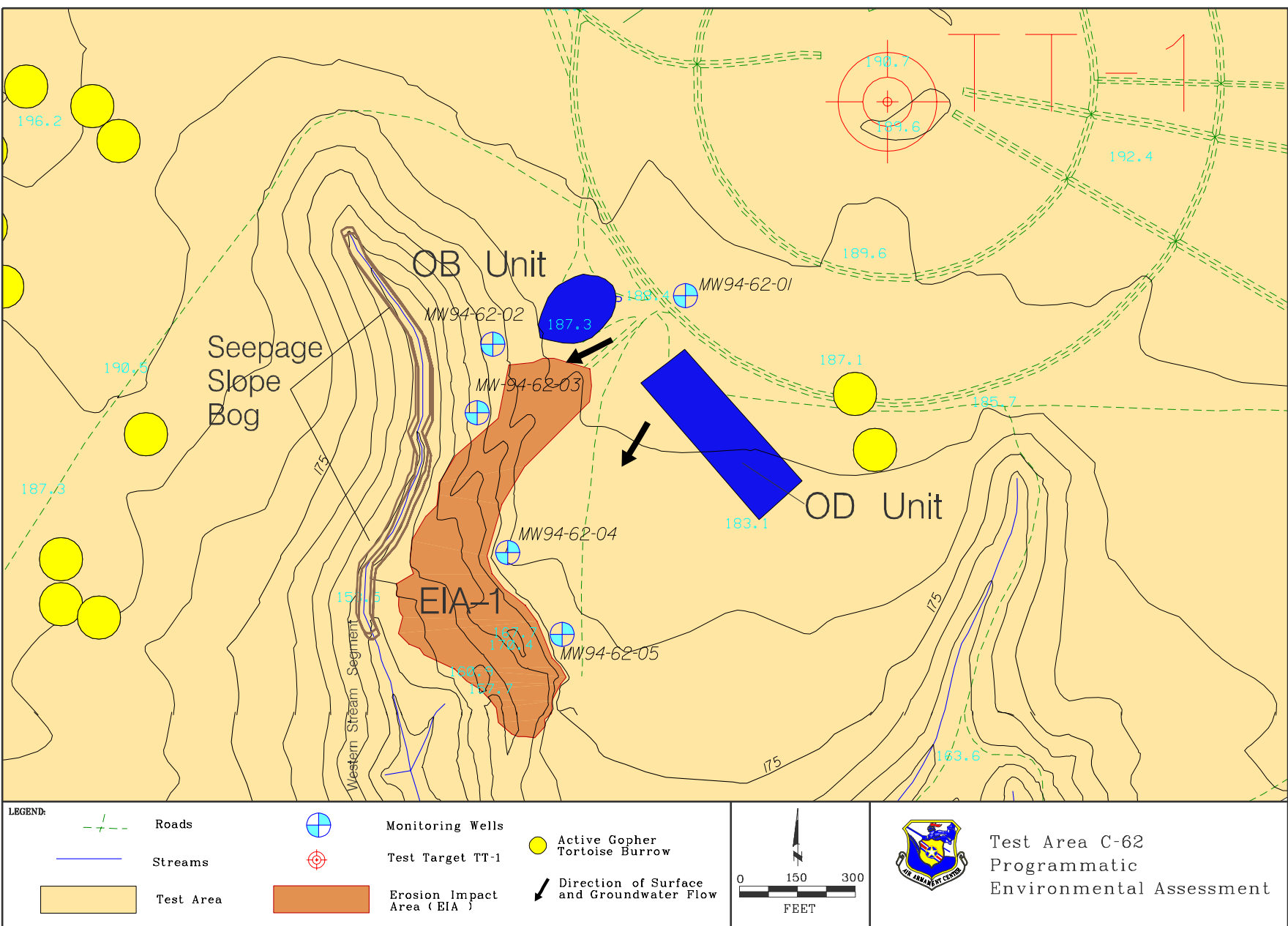


Figure 3-26. CE-EOD OB/OD Site



**Figure 3-27. Trailer Mounted CE-EOD TBKP Unit**

### Open Detonation Operations

Ammunition Disposal Requisition mission event packages of up to 3,000 pounds of energetic material are detonated by CE-EOD in two excavated pits approximately 300 feet apart within the 200 × 400-foot open detonation area located on the southern portion of TA C-62 (Figure 3-23). The pits are excavated to dimensions that suit the type and quantity of explosive materials expended with most pits being a few feet deep (Figures 3-28 and 3-29). Repeated detonation in the same pit may substantially increase the original depth and width of the blast pits.



**Figure 3-28. Detonation pit on the western portion of the CE-EOD site (August 2001)**



**Figure 3-29. Detonation pit on the eastern portion of the CE-EOD site (August 2001)**



CE-EOD OD (open detonation) events are a primary source of noise on TA C-62 and pose a potential safety hazard. The four conventional Life Critical Threats to CE-EOD personal and wildlife associated with OD events include:

- *Overpressure*: The blast pressure wave generates varying levels of compressive and shears stress that can cause critical injury to the thorax and abdominal region and permanent hearing loss.
- *Fragmentation*: Fragment impacts with the body can range from mild abrasions of the skin to fatal injuries.
- *Impact (Blast Induced Body Accelerations/Decelerations)*: The blast pressure wave can cause the body to be propelled uncontrollably from its original position, which can result in secondary impacts (decelerations) with other solid objects or the ground. Injuries can range from minor sprains to amputations and/or massive head injuries.
- *Heat (Flash and Contact Burning)*: During thermal degradation of energetic materials, intense radiant heat and/or flame (flash) is produced which could produce severe burns.

As with OB operations, there are no provisions for treating combustion by-products and controlling the scattering of debris across the test area and adjacent lands. Several federal agencies are pursuing new technologies in this area including:

- Department of Energy molten salt technology
- U.S. Army Construction Engineering Research Laboratory pyrolysis of munitions
- U.S. Army Research Laboratory supercritical fluid technology for nitramine recovery
- U.S. Army Research and Development Engineering propellant recovery technologies
- Naval Surface Warfare Center supercritical fluid propellant extraction process
- Armstrong Laboratory's hydrothermal oxidation for propellant destruction
- Holston Army Ammunition Plant's recovery of waste explosives

### CE-EOD IRP/AOC Site

Contamination of the Surficial Aquifer has occurred through past base-related activities on Eglin AFB. This section identifies existing conditions or features that characterize historic and active human influence on the environment associated with TA C-62. The test area contains one former IRP site. This is Site OT-47, the CE-EOD OB/OD Site. IRP sites are managed via the Air Force's Installation Restoration Program. Site OT-47 contained two burn/detonation metal bins used for burning and detonating inert munitions and waste explosives since the 1960s. The site has been operating under a permit issued by the U.S. Environmental Protection Agency and Florida Department of Environmental Protection since October 3, 1996. As a permitted facility, the site is off the IRP list and is now an AOC site.

In compliance with RCRA Part B Subpart X Permit No. H046-286388 issued by the FDEP in October 1996 to perform open burn/open detonation of munitions on TA C-52 and TA C-62, a detection monitoring program was established to assess the potential for elevated levels of

constituents of concern to enter the environment as a result of open burn/open detonation activities. The USEPA and FDEP determined that the majority of regulations pertaining to hazardous waste units contained in the general performance standards of 40 CFR 264, Subparts A through I, as well as Subpart X pertaining to miscellaneous units, apply to open burn/open detonation activities at TA C-52 and TA C-62.

One upgradient background well (MW94-62-01) and four point of compliance (POC) wells were installed at TA C-62 (Figures 3-26 and 3-30). The depth of the well and depth to groundwater for each well is presented in Table 3-6. Groundwater is sampled quarterly at each well at TA C-62 and analyzed for explosives, nitrate/nitrite nitrogen, total dissolved solids, total suspended solids, benzene, toluene, ethylbenzene, and xylenes (BTEX). Monitoring for metals such as lead, copper, and aluminum is not included. Constituent monitoring parameters and concentration thresholds are listed in Table 3-7.

**Table 3-6. Monitoring Well Depth Data**

<b>Monitoring Well</b>	<b>Well Depth (ft) Following Construction</b>	<b>Depth to Groundwater (ft)</b>
MW94-52-01	34.35	16.45
MW94-52-02	38.90	10.91
MW94-52-03	39.80	11.55
MW94-52-04	39.00	19.43
MW94-52-05	39.50	20.10

In compliance with the permit, sampling results are compared with USEPA and Florida state drinking water standards, including Safe Drinking Water Act Maximum Contaminant Levels (MCL). Results for analytes with no established drinking water regulatory criteria are compared to the analytes Practical Quantitation Limit (PQL), which does not represent a risk-based concentration. The PQL is the minimum concentration of a chemical that can be measured and reported in accordance with the Quality Assurance Project Plan. Well sampling data exceedences of 1994 Florida standards and PQLs at four times the MDL are presented in Table 3-8. As allowed by the permit, Eglin reverted to a non-replicate sampling protocol after the first full year of sampling (CH2MHill, 2000).

Groundwater monitoring detected 2,4-dinitrotoluene at concentrations that exceeded Florida drinking water standards and nitroglycerin and 4-amino-2,6-dinitrotoluene at concentrations four times greater than the Method Detection Limit (Table 3-7). Detection of exceedences for nitroglycerin and 4-amino-2,6-dinitrotoluene in the upgradient background monitoring well (MW94-62-01) suggest that sources of contamination other than the CE-EOD OB/OD unit, such as buried unexploded ordnance from historic missions, may exist.

**Table 3-7. Groundwater Monitoring Constituents and Concentration Thresholds**

Constituents	Threshold Concentration (µg/L)*
Benzene	1
1,3-dinitrobenzene	50
2,4-dinitrotoluene	0.2
2,6-dinitrotoluene	0.2
4-amino-2,6-dinitrotoluene	PQL
2-amino-2,6-dinitrotoluene	PQL
Ethylbenzene	30
HMX	1,800
Nitrate	10,000
Nitrite	1,000
Nitrogen, ammonia	PQL
Nitrogen, total	PQL
Nitroglycerine	PQL
Nitroguanidine	700
2-nitrotoluene	61
3-nitrotoluene	61
4-nitrotoluene	61
PETN	PQL
RDX	10
Sulfate	250,000
Sulfide	PQL
1,3,5-trinitrobenzene	60
2,4,6-TNT	10
Tetryl	370
Toluene	40
Xylene	20

\* Florida state drinking water standards including Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act

PQL = Practical Quantitation Limit

**Figure 3-30. TA C-62 OB/OD Groundwater Monitoring Well MW94-62-03****Table 3-8. Groundwater Monitoring Well Compound Exceedences of Screening Levels<sup>a</sup>**

Compound	Groundwater Monitoring Well Data (µg/L: Sampling Quarter) <sup>b</sup>					Florida Standard
	Background MW94-62-01	POC MW94-62-02	POC MW94-62-03	POC MW94-62-04	POC MW94-62-05	
Nitroglycerin	1.9:13 <sup>th</sup>	1.7:13 <sup>th</sup>	3.7:13 <sup>th</sup>	—	BDL	ND
4-Amino-2,6-Dinitrotoluene	—	1.5:2 <sup>nd</sup> 0.93:3 <sup>rd</sup> 1.8:13 <sup>th</sup> 2.2(2.3):14 <sup>th</sup>	1.4:13 <sup>th</sup> 2.2:14 <sup>th</sup>	1.1:3 <sup>rd</sup>	BDL	ND
2,4-Dinitrotoluene	—	0.22:1 <sup>st</sup> 0.25:3 <sup>rd</sup>	0.23:3 <sup>rd</sup>	0.2:3 <sup>rd</sup>	BDL	0.20 µg/L

<sup>a</sup> First quarter monitoring performed in September 1996 and fourteenth quarter monitoring performed in November 1999.

<sup>b</sup> Exceedences of screening levels include PQL at four times MDL.

POC = Point of Compliance BDL = Below Detection Limit ND = Not Determined

Source: CH2MHill, 2000

### 3.4.3 Unexploded Ordnance (UXO) and Debris

#### UXO

DoD defines explosive ordnance as any munition, weapon delivery system, or ordnance item that contains explosives, propellants, and chemical agents. UXO is defined as explosive ordnance

that has been primed, fuzed, armed, or otherwise prepared for action, and that has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard, and that remains unexploded by malfunction, design, or any other cause (Federal Advisory Committee for the Development of Innovative Technologies, 1996). Unexploded ordnance is arguably the most serious and prevalent environmental problem facing DoD facility managers. The presence of unexploded bombs presents an obvious safety hazard; however, even inert practice bombs such as the BDU-33 have an explosive spotting charge that could be an explosive safety concern if it does not function properly on ground impact. The types of UXO that may occur on TA C-62 include small arms munitions, rockets, projectiles, submunitions, and bombs.

According to a study by the Eglin AFB Directorate of Safety (U.S. Air Force, 1976), approximately 330 square miles of the Eglin reservation are potentially contaminated with various types of explosives. Study results were based on interviews, written records, and maps and photographs dating back to 1935. The potential for UXO on TA C-62 is a product of historic and present-day mission activities. Historically, the test area has been used for bombing and gunnery training with special emphasis on gunnery and radar activities in 1944. In 1953, test area mission capabilities were modified to support air-to-surface gunnery, high altitude bombing, dive-bombing, and rocketry. Toss bombing was conducted from runs varying from 5 to 85 degrees. In 1965, the TA C-62 clay landing strip was used by the Special Air Warfare Center (SAWC) Tactical Air Command to practice assault landings. Aerial photographs from 1969 identified a heavily scarred area east of target TT-1 with craters obscuring another possible target. At target area TT-3, two 1,000 foot rectangular clay pits with standing targets were used for aircraft gunnery strafing missions. By 1993, two small bombing targets TT-4 and TT-6 had been added to the test area.

The southern portion of TA C-62 may be contaminated with high explosive (HE) bombs. Other potential munitions UXO includes HE bombs, mines, rocket and missile warheads, projectiles (over 5 pounds NEW), HE rocket warheads practice bombs, projectiles (under 5 pounds NEW), napalm bombs (igniter/buster hazard), and incendiaries including flares. Expended white phosphorous rocket warheads contained an explosive burster, which compounds the hazard of dud rockets (U.S. Air Force, 2000e).

Present-day TA C-62 munition expenditures and CE-EOD OB/OD operations are also considered a potential source of UXO. During open detonation operations, there is a potential that some of the explosive items in the detonation package may not be detonated by the C-4. As an example, a live 20 mm round was identified near target TT-3 (Figure 3-31a). TT-3 is a low angle-strafing target used for high performance aircraft 20 mm gunnery training. During aircraft gunnery training, the spent shell casing is contained in the aircraft gun system drum. The best estimation of the source of this live 20 mm round is the CE-EOD OB/OD unit, which is approximately 1,200 feet to the southeast (Figure 3-23). Based on this evidence, it is assumed that there is the potential that the test area and surrounding woodlands may be contaminated with UXO for up to a quarter-mile as a consequence of CE-EOD OB/OD operations.

A disposal pile of 20 mm and 30 mm ammunition was discovered in the woods near TT-3 (Figure 3-31b). Targets TT-1, TT-3, TT-4, and TT-6 are heavily littered with various types of inert munitions ranging from aircraft gunnery ammunition to MK-82s (Figure 3-32). Test area personnel estimated that it has been 12 years since cleanup operations have been performed on TA C-62.





**3-31a.** Live 20 mm Round Near Target TT-3



**3-31b.** TT-3 20/30 mm Ammunition Disposal Pile

**Figure 3-31. Aircraft Gunnery Target TT-3 UXO and Debris**



**3-32a.** TT-3 Gunnery Strafing Debris



**3-32b.** Target TT-6 Munitions Debris



**3-32c.** Target TT-6 MK-82



**3-32d.** Target TT-1 BDU-33 Debris Area

**Figure 3-32. Targets TT-1, TT-3, and TT-6 Munitions Debris**

Regulatory drivers impacting UXO issues are most frequently associated with the Base Realignment and Closure (BRAC) and Formerly Used Defense Site (FUDS) processes involving the transfer of DoD property to the private sector or other agencies. The transfer of responsibility for DoD land to other entities invokes compliance with Superfund statutes and Section 2908 of the 1993 Public Law 103-160 requiring adherence to CERCLA provisions. Typical issues of concern include assumption of liability for ordnance contamination. With the passing of the Munitions Rule, the UXO present at the CE-EOD OB/OD site may be considered to be RCRA wastes because they have undergone disposal. UXO present within active and inactive ranges are excluded from the rule pending the adaptation of the Proposed Range Rule. Since TA C-62 is still part of an active Air Force Munitions Testing Range, these regulatory drivers do not apply.

Standard technologies typically used to detect, characterize, and remediate UXO problems have proven to be slow, labor intensive, and inefficient. Investigations have been conducted on TA C-62 to introduce and test more effective UXO detection and discrimination methods. In 1998, The U.S. Army Research Laboratory, under the sponsorship of the Strategic Environmental Research and Development Program, established an area on the western portion of TA C-62 for establishing and enhancing the ability of the low-frequency, ultra-wideband (UWB) synthetic aperture radar (SAR) to detect and discriminate unexploded ordnance (UXO). The UXO test area situated adjacent to the western boundary of TA C-62 is approximately 3,300 feet × 330 feet and is about 165 feet to the west of the clay landing strip.

For testing purposes, 503 inert targets, including mortars, artillery, submunitions, rocket warheads, bombs, and mines are placed at the surface and buried at precise locations, depths, and orientations to represent realistic scenarios and provide researchers with a diversity of parameters for implementing and evaluating data processing techniques (Table 3-9). During testing, the BoomSAR system radar, elevated by a 150 foot telescoping mobile boom lift, collects data while being moved along the clay landing strip at approximately 0.6 miles per hour.

**Table 3-9. UXO Test Area Inert Target Type, Quantity, and Depth**

Target Type	Surface or Flush	Subsurface to 0.5 ft	Subsurface to 0.5 – 1 ft	Subsurface to 1 – 2 ft	Subsurface to 2 – 3 ft	Subsurface to 3 – 6 ft
Artillery Shells						
105 mm	8	10	16	8	–	–
155 mm	11	–	11	21	8	–
Rocket Warheads						
2.75	4	8	8	4	–	–
2.75 w/HE case	4	–	16	4	–	–
Mortar Shells						
60 mm	8	24	8	–	–	–
81 mm w/tail	1	4	–	4	–	–
81 mm w/o tail	8	4	18	4	–	–
Submunitions						
BLU-97	8	28	–	–	–	–
M-118	14	24	–	–	–	–
BDU-28	16	20	–	–	–	–
Bombs						
BDU-33 w/tail	4	8	4	4	–	–
BDU-33 w/o tail	8	8	8	4	–	–
250 – 2,000 lb.	2	–	–	2	–	4
Mines						
Gator	8	35	–	–	–	–
VSI.6	4	12	–	–	–	–
M20	4	8	–	–	–	–
Volcano	4	12	–	–	–	–
TTCP Simulant	4	4	–	–	–	–
Plastic Simulants	6	12	–	–	–	–
<b>Subtotals</b>	126	221	89	55	8	4
					<b>Total</b>	<b>503</b>

Within the 25 acre UXO test area (Figure 4-1), the 503 target items are placed along 85 rows ranging from 300 feet to 330 feet in length. Rows 1 through 50 are 23 feet apart and rows 51 through 85 are 33 feet apart. A maximum of 10 to 14 targets is placed on a row a minimum of 23 feet apart. The first location in each row, located approximately 164 feet from the clay runway, is reserved for the future placement of one foot long rebars to serve as registration targets. Surface items are placed immediately prior to testing; additional items are also added at predetermined intervals during data collection. Pre-existing UXO, primarily BDU-33s, were removed from a 6.5 foot radius area surrounding test target locations.

In February 1998, AF813 – RCS#98-031 was submitted to perform BoomSAR testing on the UXO test area on TA C-62. The proposed action qualified for a Categorical Exclusion (CATEX) with provisions for gully repair and tree removal. The precision of the soil excavations for target item burial allots field personnel an opportunity to avoid impacts to potential burrowing owl and gopher tortoise burrow habitats during testing operations.

### Debris

Historically, TA C-62 ordnance debris and target materials such as lumber, cloth, concrete, and metals were stockpiled along the north boundary of the test area near target TT-3 or other

locations (Figure 3-32). Typically, CE-EOD OB/OD debris is also stockpiled on or near the test area. Once stockpiled, materials can be disposed of according to established procedures.

The first step in the disposal process is to have the debris cleared by EOD to ensure that no explosive materials are present. Once the debris is determined to be safe, recyclable items are segregated. Wood is mulched and composted at Eglin's recycling center on the main base or the Wright Compost Facility in Fort Walton Beach. Other recyclable items, for which specific procedures have been established, are sent to one of two staging areas to await sale and transport by private vendors. Prior to the sale, the candidate recyclable materials are inspected by the Defense Reutilization and Marketing Office (DRMO).

Policies for the retrieval of debris are in place for some user groups and limitation on where certain items can be expended, such as pyrotechnics in wetlands, are a range-wide policy. A Memorandum of Agreement (MOA) between the DRMO and several AAC organizations has been approved to address the disposal of recyclable materials with regard to disposal procedures and responsibilities. It will be amended in the future for specific waste streams. Consequently, certain types of debris are being stockpiled until all parties agree to the terms of the amendment. The MOA will be amended for handling and disposition procedures for various waste streams. AAC/EMC, 96CEG/CED, 46T, 96AMDS/SGPB, DRMO-VHH, and DRMS Eastern Region has been approved to address the salvaging of unwanted mobile targets. Recyclable items for which procedures have not been established continue to be stockpiled on the test area until procedures are finalized. Items that cannot be recycled are handled as sanitary waste and are transported to local landfills. Hazardous waste items are handled in accordance with Eglin's Hazardous Waste Plan.

The Explosive Ordnance Disposal Division (96 CEG/CED) is responsible for clearing targets of live and inert munitions prior to and following a mission and periodic removal from the test areas of the UXO or other expendables that contain or potentially contain explosive material. TA C-62 is also to be cleaned on an annual basis in addition to post mission cleanups. The high density of debris on TA C-62 is the result of non-enforcement of current cleanup policies.

Explosive waste is regulated under the RCRA pursuant to the Military Munitions Rule. As a consequence, the FDEP has issued a permit to Eglin regulating and specifying the amount and storage of ordnance components, the open burning of these items, and their open detonation. Also included in the permit are reporting and sampling requirements (U.S. Air Force, 1999).

### **3.4.4 Test Area Roads**

Eglin Air Force Base has approximately 2,700 miles of paved and unpaved roads that provide a diversity of military mission functions. Of the 2,700 miles of roads on Eglin, approximately 945 miles (35 percent) are within test area gates. Some roads are heavily used, while others experience infrequent or seasonal use. The necessity of the Eglin road system is indisputable as is its impact on the environment.

The extensive road system built and maintained over the last 65 years on Eglin's test areas has become an integral part of the landscape. Roads are directly linked to the form and function of ecosystems and ecological processes; ridges are linked to midslopes, which are linked to

bottomlands, which are linked to aquatic systems. Aquatic systems transport nourishment for organisms and are primary agents of topography and soil development that support watershed ecosystems and ecological processes.

Although the Eglin test area road system occupies a relatively small portion of the Eglin landscape, its contribution to the impairment of the water quality and morphology of Eglin's streams and wetlands and alteration to natural drainage patterns has been dramatic. Sediment introduced into a stream can alter channel width, depth, flow gradients, and aquatic habitat features such as pools and riffles, which subsequently alter its use by organisms. Additional information on Eglin's road system is provided in the *Range Road Draft Programmatic Environmental Assessment* (U.S. Air Force, 2000b).

The approximately 11 miles of unpaved tertiary and other roads on TA C-62 provide access to control buildings, spotting towers, CE-EOD OB/OD unit, and test area targets TT-1, TT-3, TT-4, and TT-6 (Figure 3-33). Most roads receive little or no maintenance. The exception, Range Road (RR) 380 along the northern boundary of the test area, has been surfaced with crushed limestone but is suffering from severe erosion that is compromising the trafficking integrity of the road.

### **Road/Stream Intersection**

The most direct interaction of test area roads and aquatic systems is the intersection of roads and streams. As the road tops the ridgetop and descends along the valley midslope towards the stream, it has a dramatic affect on watershed hydrology by creating a new, impervious channel that effectively concentrates runoff, diverts natural drainage patterns, and extends the existing drainage network.

Although accelerated erosion may occur at any road location experiencing concentrated water flow, the intersection of roads and streams becomes a focal point of direct impact to aquatic ecosystems. Depending on the slope grade and watershed drainage area, the concentrated flows left to their own devices will typically create intermittent channels or gullies that can carry sediment directly into the stream. The intersection of RR380 and an unnamed stream flowing into Oakie Creek is the only known active stream crossing on TA C-62 (Figure 3-33). An abandoned crossing has been identified on the western headwater stream segment of Blount Mill Creek (Figure 3-33).

### **Roads Parallel to Stream Slopes**

Although less obvious than roads that cross streams, test area roads placed across stream slopes or along the crest of a stream slope can be problematic. Most of these roads were established with little or no consideration for their position in relation to natural drainage patterns and their direct linkage to streams. In the absence of proper road construction and maintenance and implementation of erosion and runoff control practices, water flows intercepted by test area roads parallel to stream slopes frequently result in severe soil erosion of the road and adjacent slopes. RR 380 and the target TT-6 and TT-4 access road that run parallel to Oakie Creek have evolved into primary sources of erosion and stream sediment loading (Figure 3-33).

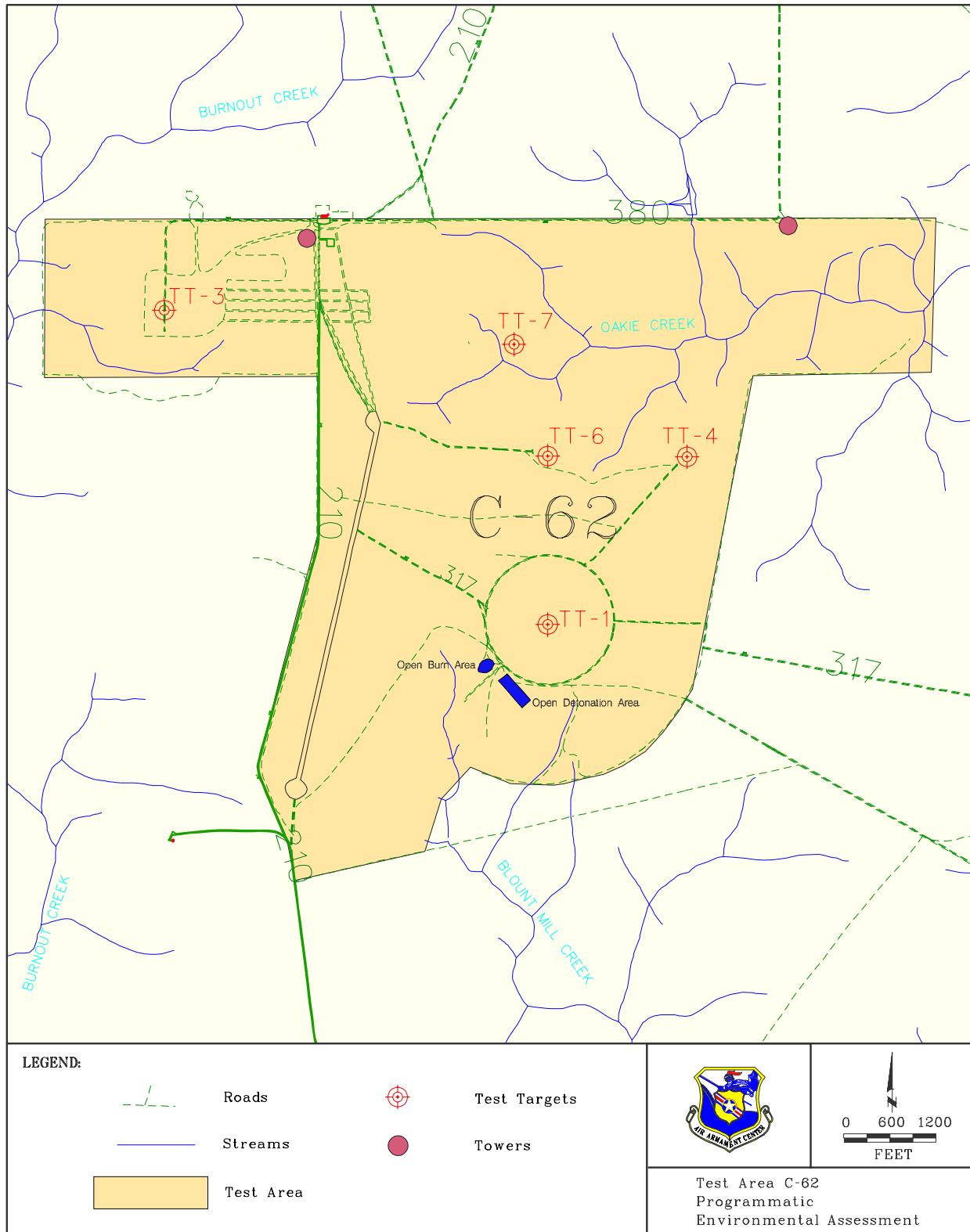


Figure 3-33. Test Area Road System

Over time the loose sand or clay road fill is washed away, exposing the cemented soil of geologic formations that are relatively resistant to water infiltration. Unabated road erosion lowers the road template below the grade of natural ground, which equates to a road functioning as a water channel.

During storm events, watershed drainage follows natural patterns towards stream outlets. Degraded roads that intersect these drainage areas effectively collect and concentrate water flows. Once the collected water finds a point of least resistance along the stream slope, it increases in velocity and can create gullies that transport large amounts of sediment to streams.

Degraded roads that serve as stormwater conduits also create potential direct routes of transport that could expose aquatic systems to various types of chemical materials (particulate matter, metals, and other chemical residues) generated during mission events at nearby test targets. Effects can range from long-term contributions of sediments to catastrophic failures of stream crossing culverts or bridges. Recovery intervention in the accelerated erosion processes associated with road/stream segments then becomes of primary importance.

### **TA C-62 Road Condition Assessment**

Field assessment of the unpaved road on TA C-62 produced the following findings:

- Roads are eroding at accelerated rates and are sources of sediment and nonpoint source pollution.
- The configurations of some roads are below the grade of natural ground and serve as erosive water channels that transport sediment directly into streams.
- Overall, roadside Best Management Practices (BMPs) such as straw bales and silt fences are not functioning to their design capacity because of improper design, placement, and/or the lack of maintenance.
- On some roadside slopes, unabated, long-term soil erosion has exposed sterile, unstable geologic formations that are generally void of vegetation.

It is concluded that:

- Portions of the TA C-62 road system are experiencing accelerated rates of erosion that is adversely impacting the environment and road system management.
- Stream and wetland ecosystems have been directly impacted in terms of form and function by the introduction of sediment from road-induced soil erosion.

### **3.4.5 Erosion Impact Areas**

Erosion Impact Areas (EIAs) are the areas on TA C-62 that have been identified as sites of active soil loss by water erosion (Figure 3-34). TA C-62 EIAs include:

- Blount Mill Creek Headwater (EIA-1)
- Oakie Creek Ridge Road (EIA-2)

- Oakie Creek North Boundary RR 380 (EIA-3)
- Burnout Creek Headwater (EIA-4)

### Soil Erosion

Soil erosion is a three-phase process of detachment, transport, and deposition of surface materials by water, wind, ice, or gravity initiated by drag, impact, or tractive forces acting on individual soil particles. It is a relentless process that is nearly impossible to stop, difficult to control, and easily accelerated by humans. The process of water erosion is directly linked to the behavior of water as it encounters and/or moves over the ground.

During rainfall events, water that reaches the surface is stored in depressions or infiltrates into the soil. When the soil is unable to take in more water, the excess moves downslope to areas of concentrated flow resulting in overland flow erosion. According to Wischmeir and Smith (1958), the intensity and duration of precipitation is the most important climatic factor controlling rainfall erosion.

Accelerated erosion occurs at rates much greater than natural erosion and has been shown to adversely impact terrestrial and aquatic environments, damage or destroy cultural resources, reduce recreation use and value of affected watersheds, and increase management and operating costs. Surface erosion accelerated by human actions depletes and/or degrades the physical, chemical, and biological constituents that are essential to ecosystems. Unabated soil erosion reduces ecosystems to skeletal assemblies of raw materials from which healthy, self-sustaining ecosystems must be reconstructed.

The common attribute of each TA C-62 EIA is repeated surface disturbance that prevents the recovery of vegetative cover resistant to erosion. The barren landscapes created by erosion may remain bare for extended periods despite yearly bombardments of seeds by native plants.

In the absence of human intervention, the site will not recover until one or more of the following natural healing processes ameliorate the adverse conditions:

- Soil shear stress caused by flowing water is reduced.
- Soil chemistry problems such as pH extremes, nutrient deficiencies, and/or toxic chemical levels are leached or otherwise amended to tolerable levels. The slope angle of repose is modified by erosion and sedimentation to a stable grade.
- Algae and lichens moderate high soil temperatures, soil moisture retention, and accumulate nutrients or organic matter on sterile sands.
- Inordinate combinations of favorable weather conditions occur.

These natural processes may take hundreds or thousands of years. In the meantime, the frequent consequences of human activities without recovery intervention may convert a productive landscape into a source of pollution and ecosystem degradation.

A detailed discussion of the soil erosion and sediment is presented in Appendix G.



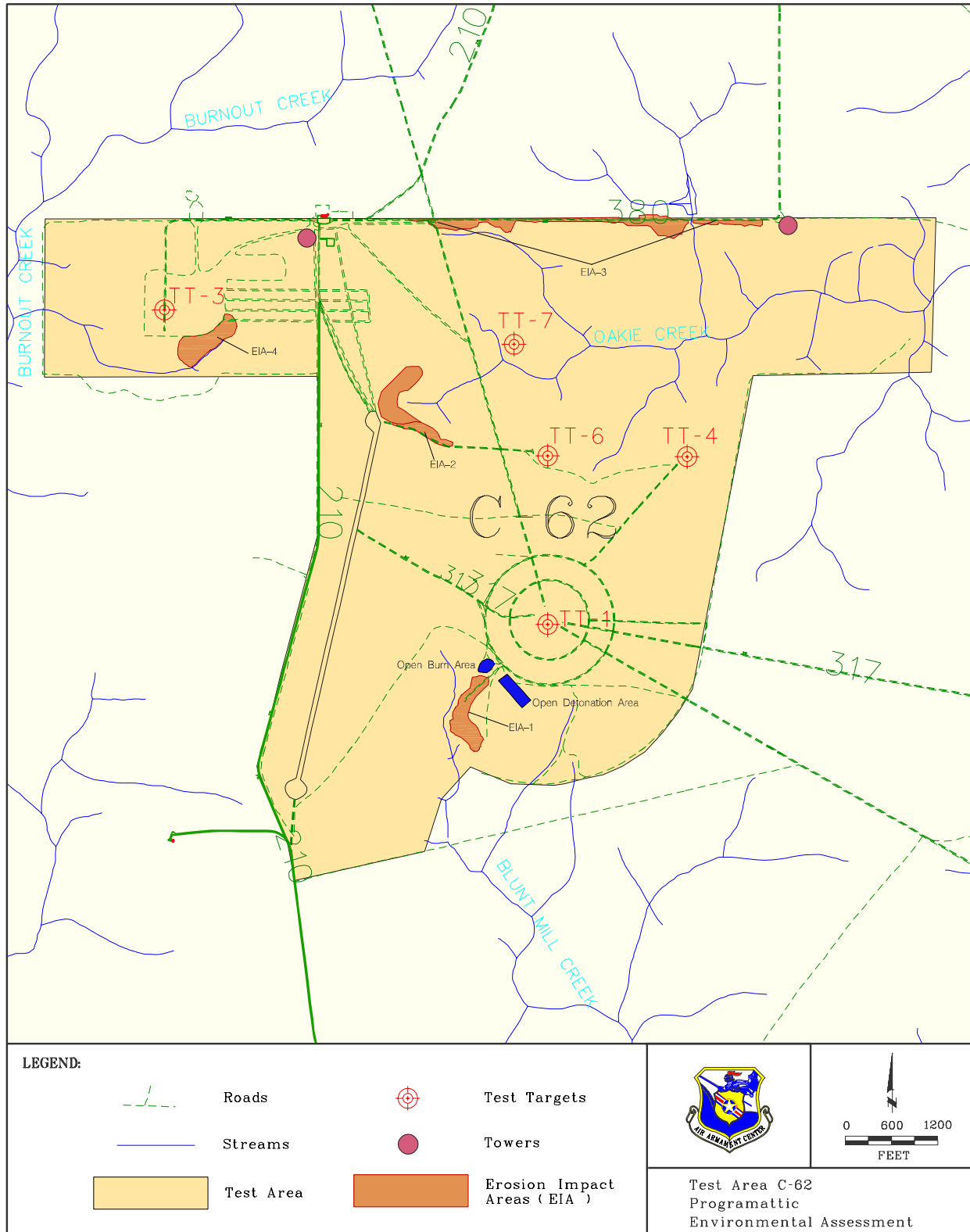


Figure 3-34. Active Soil Erosion Impact Areas

## Sediment

Eroded soil particles moved and deposited by a watercourse are known as sediment, which can adversely alter water quality, habitats, and the hydrologic form and function of waterways and wetlands. Suspended sediment in waterways inhibits light penetration and photosynthesis and diminishes the aesthetic value of water bodies. Sediment deposition in waterways leads to premature filling of waterbodies, exertion of large oxygen demands on the water, burial of benthic organism aquatic habitats, and alteration of stream hydrology. Sediment deposition on other terrestrial systems can bury and kill vegetation and other organisms.

Environmental damage potentials may be further expounded by the introduction of materials such as organic matter and soil-bound nutrients, metals, or other compounds to receiving ecosystems. Sedimentation directly and indirectly impacts threatened and endangered wildlife and vegetation by altering habitats to a point that may exclude its use by species of concern.

## Regulatory Considerations

The extent of effects associated with soil erosion is not limited to on-site eroded soil deposition, but includes off-site pollution potentials. Once eroded soil materials move off-site and are embodied by other aquatic or terrestrial systems, the erosion product(s) become a nonpoint source pollutant and are subject to state and/or federal regulatory constraints.

Whereas point source pollutants have a localized identifiable source such as a pipe, nonpoint source pollutants originate from an unconfined source, typically a relatively large land area. Erosion on TA C-62 that facilitates the transport of soil materials and other compounds beyond the boundaries of the test area is considered nonpoint source pollution.

Air Force Instruction 32-7041, Water Quality Compliance (Appendix B), stipulates that the Air Force maintain compliance with the Clean Water Act (CWA) and other federal, local, and state environmental and water quality directives. In adherence to the Department of Defense proactive approach to minimizing and mitigating adverse environmental effects, it is prudent to address the extent and potential impacts associated with accelerated erosion on TA C-62.

## Clean Water Act

Water quality regulation in the United States is largely based on the maintenance and enhancement of the designated beneficial uses of water. The Clean Water Act's (CWA) overall goals and amendments are couched in terms such as "swimmable," "fishable," and "the propagation of aquatic life." The policies and mechanisms to achieve these goals such as water quality standards, best management practices, and antidegradation all relate back to this concept of the designated beneficial use of the water body. Recent Florida legislation has created opportunities for U.S. Environmental Protection Agency enforcement of CWA beneficial water use policies and mechanisms.

In 1972, the Federal Water Pollution Control Act or Clean Water Act was amended from its original form and signed into law (P.L. 92-500). The intention of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The two sources of water pollution defined by the CWA are point source and NPS pollution. Point source is a

discrete, identifiable discharge point and NPS is the result of toxic and/or nontoxic substance entrance into water bodies through storm event runoff from snowmelt, translocation by wind, and precipitation.

In crafting the CWA, Congress excluded NPS pollution from regulatory enforcement because point source pollution was considered the primary source of water pollution and sources of NPS pollution are difficult to isolate. However, the U.S. Environmental Protection Agency (EPA) considers sedimentation (a NPS pollutant) the second leading cause of water quality impairment.

NPS pollution control compliance is primarily voluntary and does not fall under the permitting scope of the National Pollution Discharge Elimination System (NPDES). To mitigate, Congress enacted Section 319 of the CWA to provide states with grant allocations to develop NPS management plans and implement Best Management Practices (BMPs).

The Clean Water Act (CWA) as amended in 1987, Section 319, placed special importance on the need to control nonpoint source pollution. The CWA states that nothing can be introduced into a stream or other water body that could potentially pollute the water, and that programs for the control of nonpoint sources of pollution should be developed and implemented in an expeditious manner so as to enable the achievement of the nonpoint source goals of the CWA. Historically, the CWA has lacked nonpoint source pollution enforcement mechanisms. However, in response to lawsuits by environmental groups, the EPA has developed a program to enforce the control of nonpoint source pollution. The EPA seeks to enforce Section 303 (d) of the CWA by requiring state agencies to establish Total Maximum Daily Load (TMDL) plans for listed impaired water segments.

### ***Florida Watershed Restoration Act***

The 1999 Florida Watershed Restoration Act (FWRA) established regulatory authority for the enforcement of Section 303(d) of the CWA to control water quality impairment by targeting point source as well as nonpoint (NPS) sources of water pollution. Where water quality is deteriorating, NPS pollution is frequently the major cause. Under the auspices of the FWRA, the U.S. Environmental Protection Agency can regulate NPS pollution associated with erosion and water body sedimentation. The FWRA establishes the TMDL authority and process for the State of Florida and the process for listing impaired waters and developing, adopting, and implementing TMDL Plans that facilitate compliance with federal law. Prior to the Act, NPS compliance was primarily voluntary.

The EPA and other states are engaged in legal actions with environmental groups that contend that federal and state agencies have failed to meet the requirements of Section 303(d) of the CWA. Representing the Florida Wildlife Federation, the Earth Justice Legal Fund (formerly the Sierra Club Legal Defense Fund) filed a major lawsuit on 22 April 1998 against the EPA requiring the agency, under the auspices of the Clean Water Act, to set water quality standards (TMDLs) for polluted lakes and streams in Florida. After the EPA determines the TMDL that Florida water bodies can absorb, the Florida Department of Environmental Quality would be forced to control water quality impairment until water quality standards were reached by targeting all sources of pollution (point and nonpoint) entering a specific system.

Section 303(d) of the CWA and EPA regulation (40 CFR 130.7) require states to develop and maintain a current Water Quality Listed Segments (WQLS) list of stream and/or stream segments that do not meet or are not expected to meet applicable water quality standards (pollutant or biological standards) for the stream's designated use. States must stay current on listing and setting Total Maximum Daily Loads (TMDL) every two years. The State prioritizes WQLS water bodies in order to schedule TMDL development. For WQLS segments, TMDL standards for maximum allowable concentrations of specified pollutants or biological criterion are set.

EPA has established a policy that requires states to establish a schedule for completing TMDLs, with expectations that these schedules not exceed 8 to 15 years. If the state fails in this effort, the EPA may intervene without discretion to uphold the intent of the CWA (Hasenstein, 2000). A survey of Midwest states by the Indiana Department of Environmental Management found that the average cost of a TMDL plan, not counting the cost of plan implementation, was \$100,000 (Florida Farm Bureau Federation, 2000).

The FWRA may have serious implications for Florida counties, municipalities, agriculture, industries, and federal installations. The importance of this legislation is that it directly affects ALL point source and nonpoint source discharges into water bodies by establishing a regulatory authority for water pollution control. In other states where TMDL suits have been brought, the courts have been asked to modify, revoke, reissue, or terminate existing permits as necessary to meet established TMDLs.

Additional information on potential implications of the FWRA and TMDL program may be obtained by contacting the Florida Department of Environmental Protection. A copy of the Florida Watershed Restoration Act of 1999 is presented in Appendix B.

### ***WQLS Impact Potentials***

A state 303(d) WQLS potentially influenced by TA C-62 is Choctawhatchee Bay (Figure 3-35). The TA C-62 avenues of potential water quality impact are Oakie Creek and Blount Mill Creek. These creeks flow into Alaqua Creek, which flows into Alaqua Bayou and into Choctawhatchee Bay. Although it is over five miles from TA C-62 to the outflow point at Alaqua Bayou, there is still the potential for test area mission related activities to contribute to the overall water quality of the watershed. This becomes a more relevant issue when considering stream morphology and flow regimes and contaminant sinks that typify most northwest Florida watersheds.

It is the relative absence of in-stream organic or clay substrates and water residence that limits the capacity of some stream channels to capture and bind water-borne constituents in stream sediments. In comparison, as water flows are reduced and passed over organic substrates and through plant biomass within wetlands, there are opportunities for a diversity of interactions that tend to remove constituents from the water column or alter their chemical form or condition.

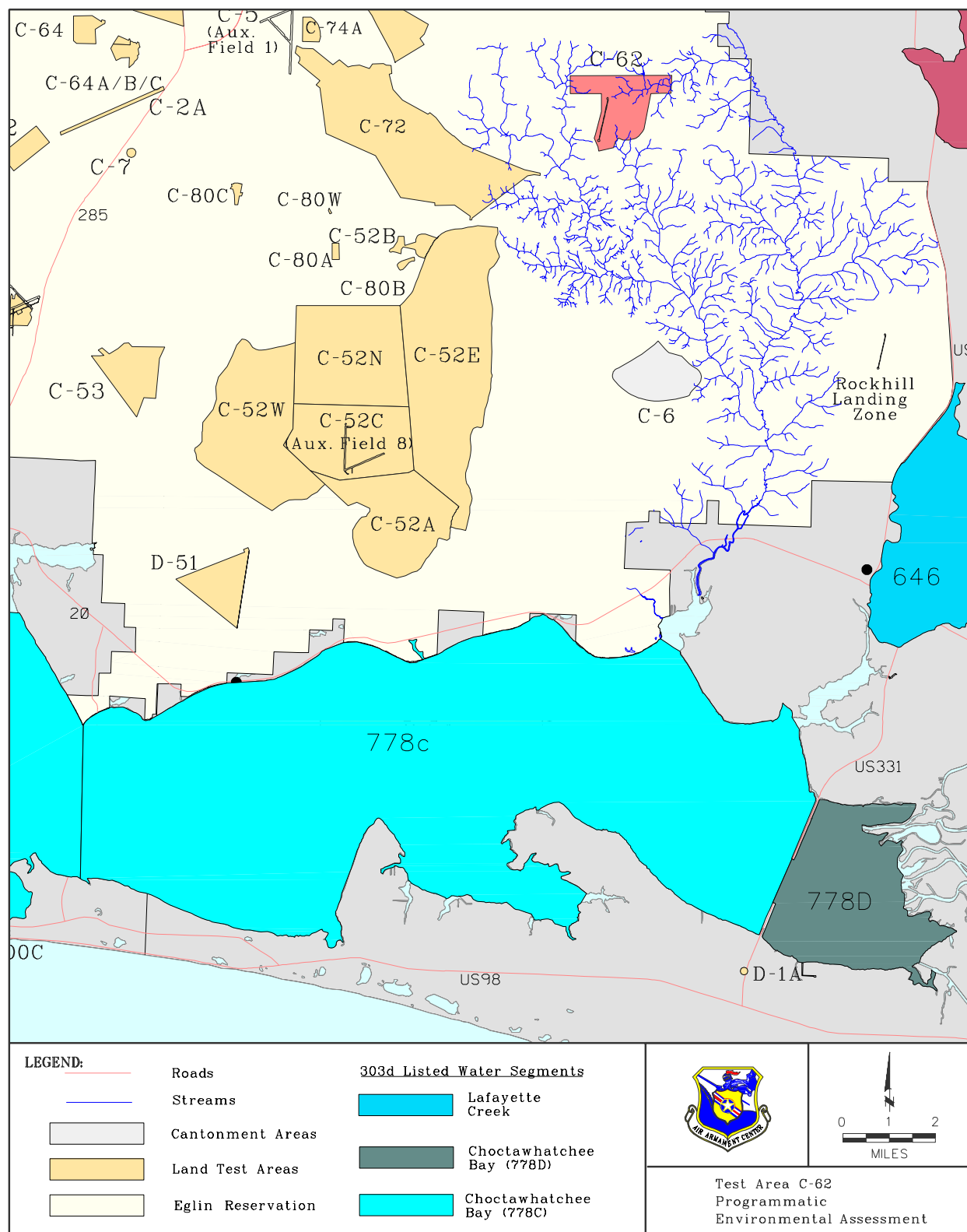


Figure 3-35. Choctawhatchee Bay WQLS Potentially Impacted by TA C-62

Unless captured by aquatic flora and fauna or chemically altered by hydrolysis, photolysis, biodegradation, or other process in the water column, the majority of water constituents confined to stream channels could move relatively uninhibited from the point of entry at TA C-62 to the point of outfall at Alaqua Bayou and eventually into Choctawhatchee Bay. Alaqua Bayou has a shallow sandy bottom relatively low in organic enrichment. Inversely, the deep areas of the bay are characterized by fine silt/clay sediments and relatively high levels of organic matter (Livingston, 1987).

Occupying a watershed outflow position, the deep-water sediments of the Choctawhatchee Bay also serve as a primary sink for water borne materials and contaminants. Over time, riverine particulate matter and other materials settle out to become components of deep area sediment sinks. Sediment deposition and accumulation rates in the bay depend greatly on the rate of freshwater inflow and access to flushing from the Gulf of Mexico. Once deposited in the sediments, chemical materials may be available for uptake by benthic organisms (U.S. Environmental Protection Agency, 1999). This becomes important considering the potential links of bottom sediments to estuary biological productivity and socioeconomic vitality of the region.

The water quality parameters of concern to Choctawhatchee Bay include biochemical oxygen demand, coliforms, nutrients, turbidity, total suspended solids, mercury, and metals. A study by Livingston (1987) identified moderately high concentrations of several metals (lead, aluminum, arsenic, cadmium, copper, iron, nickel, and zinc) in bay sediments; metal concentrations were determined to be a result of natural process and enrichment by anthropogenic activities. The projected year for release of the Choctawhatchee Bay TMDL is 2009.

Considering existing point source water quality impacts to the bay from development and urbanization and relative fragile nature of the bay ecosystem in relation to potential weather impacts, the potential role of TA C-62 in the overall water quality on a watershed scale is not well understood. However, potential stream pathways have been identified that could facilitate hydraulic linkage between TA C-62 and Choctawhatchee Bay. Modeling and/or stream studies would be required to more clearly define processes involved and potential ramifications. There is also a historical perspective and climatic variable that weighs heavily on the existing and future conditions of the estuary that is well beyond the historic and future influence of TA C-62.

Aside from current chemical materials and sediment inputs into the bay, there is a diverse history of ecosystem destruction and regeneration associated with anthropogenic and natural alternations of the form and function of Choctawhatchee Bay. Prior to 1929, the bay was a large freshwater lake. To reduce flooding, a channel was dug by local residents in Destin, now known as East Pass, connecting the bay with the Gulf of Mexico. The introduction of saline water initiated a successional change in the ecosystem of the bay with dramatic changes in aquatic plants and animals. Further reducing the potential duration of a relatively static estuary condition is the reoccurring hurricanes that frequent the area. The millions of tons of sand potentially redistributed by a hurricane could initiate the reconstruction of a freshwater Choctawhatchee Lake, divert freshwater flows, or dramatically increase the influx of saline waters into the bay. The mixing of saline and fresh water with bottom sediments could also alter the concentration and distribution of contaminants.

In a more specific nature, the TA C-62 mission related nonpoint source pollution of Burnout, Oakie, and Blount Mill Creeks by land erosion and stream sedimentation discussed in the following sections could, in the near future, be included within the enforcement arm of the CWA. There are also potentials for explosives residue pollution of Blount Mill Creek associated with CE-EOD operations.

### ***Jurisdictional Wetland Protection***

Of an estimated 220 million acres of wetlands in the contiguous United States during presettlement times, over half have disappeared or been degraded primarily by agriculture and development. It is estimated that the net loss of wetlands between 1985 and 1995 averaged 117,000 acres per year; down from annual losses of 290,000 acres the previous decade. Although wetlands in the 48 contiguous states are being restored at an estimated rate of 78,000 acres per year, the overall amount of wetlands continues to shrink, preventing achievement of the “no-net-loss” goal. Even though the pressure to use wetland continues, there is renewed interest in protecting the functions and values wetlands provide such as flood abatement, water quality improvement, and fish and wildlife habitat.

Jurisdictional wetlands in the United States are protected by Section 404 of the Clean Water Act (formerly known as the Federal Water Pollution Control Act, 33 U.S.C. 1344). The regulatory definition of a wetland used by the U.S. Army Corps of Engineers (ACE) and U.S. Environmental Protection for administering the Section 404 permit programs is as follows:

Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (EPA, 40 CFR 230.3 and CE 33 CFR 328.3).”

Wetland types consist of lacustrine, palustrine, estuarine, riverine, and marine wetland systems, each with a hierarchy of subsystems, classes, and subclasses. Wetlands possess three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) hydrology. The three technical criteria specified are mandatory and must all be met for an area to be identified as a jurisdictional wetland. There is no size limit on an area to be called a wetland.

Several sections of the CWA pertain to wetland regulation including:

- Section 101 of the CWA Standards and Enforcement: Description of the objectives of the CWA that are primarily implemented through Title III (Standards and Enforcement).
- Section 301 of the CWA Prohibitions: The discharge of dredged or fill material into the waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) and Section 404 (Discharges of Dredge or Fill Material of the CWA).
- Section 401 of the CWA State Certification: Specifies additional requirements for permit review at the state level.

- Section 404 of the CWA Discharges of Dredge or Fill Material: Authorizes the U.S. Army Corps of Engineers to issue or deny permits for the discharge of dredged or fill material into U.S. waters (Title 40 – Part 230, Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Subparts A through I)

Section 404(b)(1) requires that unless exempted anyone wanting to discharge dredged or fill material in navigable waters of the United States, which include most wetlands, obtain a permit from one of the 38 Corps district regulatory offices. The permitting process provides the Corps with a mechanism for enforcing mitigation efforts. A complete suite of federal wetland regulations is managed by The Wetlands Regulation Center at (<http://www.wetlands.com/links/usage.htm>).

In 1989, the Bush administration established the national goal of “no net loss” of wetlands. Subsequently the Clinton administration expanded the goal to achieve a net increase of 100,000 acres per year by 2005. In addition, a 1990 memorandum of agreement between the Department of the Army and EPA, addressing mitigation under the CWA, states that the corps will strive to achieve a goal of no overall net loss of wetland functions and values (<http://www.mil/inet/functions/cw/cecwo/reg/mitigate/htm>).

The Florida Department of Environmental Protection (FDEP) Environmental Resource Permit program under Part IV, Florida Statutes Section 373 includes jurisdictional wetland regulations regarding dredge and fill operations in fresh and salt water.

### ***Floodplain Management***

Executive Order (EO) 11988, Floodplain Management (1977, 42 Fed. Reg. 26951), requires federal agencies to avoid adverse impacts associated with the occupancy and modification of floodplains and to avoid floodplain development whenever possible. Additionally, EO 11988 requires federal agencies to make every effort to reduce the risk of flood loss, minimize the impact of floods on human health, safety, and welfare, and preserve the natural beneficial value of floodplains. Additionally, EO 11990, Protection of Wetlands (24 May 1977, 42 Fed. Reg. 26961), places additional requirements on floodplains when considered as wetlands in the EO requiring federal agencies to avoid undertaking or providing assistance for new construction located in wetlands unless there is no practicable alternatives, and all practicable measures to minimize harm to wetlands have been implemented. Also precludes federal entities from leasing space in wetland areas unless there are no practicable alternatives.

Parts of the floodplain that are also considered wetlands will, in addition to floodplain zonings, receive protection from federal, state and local wetland laws. These laws, such as the U.S. Army Corps of Engineers section 404 Permit Program, regulate alterations to wetlands to preserve both the amount and integrity of the nation's remaining wetland resources.



**Blount Mill Creek Headwater (EIA-1)**

A severely eroded ~8.4 acre site is located along the western headwater stream of Blount Mill Creek adjacent to the CE-EOD OD/OB area (Figure 3-36). A field investigation of the approximately eight-acre site identified gully erosion, topsoil loss, and exposure of infertile geologic soil layers. Abandoned access roads were also identified on the site.



**Figure 3-36. Overview of EIA-1**

Interviews with test area personnel identified the area as a possible historic location for EOD operations that was abandoned when the land was no longer able to sustain operations. It was estimated that the site had been abandoned for at least 25 years. Remnants of historical detonation pits at the immediate edge of EIA-1 further suggests that the use of land for open detonations likely migrated from lower slope sites to locations on high ground as the slope degraded and eroded away (Figure 3-37a and 3-37b).

The site occupies a historic stream terrace that slopes toward the headwater stream. It is dissected by several active gullies that are estimated to be up to 15 feet wide and over 4 feet deep (Figure 3-37c). There are several broad footslope corridors that have formed in major water concentration points that are transporting large quantities of sediments directly to the stream during major rainfall events (Figure 3-37d).

The erosion process has exposed the relatively compact, infertile Citronelle geologic formation, which reduces water infiltration and increases the velocity and channelizing nature of water flows (Figure 3-37e). Abandoned roads have evolved into gullies that transport runoff and sediment directly to the site (Figure 3-37f).



**3-37a.** Historic detonation pit at the edge of EIA-1



**3-37b.** Historical evidence of an open detonation pit within 30 feet of the stream slope



**3-37c.** EIA-1 active gully



**3-37d.** Footslope corridor that transports sediments directly into the stream channel



**3-37e.** Gullies and slope failure has exposed the underlying Citronelle geologic formations



**3-37f.** EIA-1 access road that functions as a gully conveying runoff and sediment to the stream slope

**Figure 3-37. EIA-1 Historic Open Detonation Pits and Landscape Degradation**

The migration of sediment off the stream slope has created a sediment berm at the toe-of-slope that continues to alter the stream morphology (Figures 3-38a and 3-38b). Long-term erosion and



sedimentation has filled in a portion of the stream. Decades of erosion have created a broad, braided stream channel choked with instream vegetation and exhibiting minimal channel definition (Figure 3-38c). Under undisturbed conditions, upland headwater streams typically maintain an incised channel configuration. The site was also littered with various types of CE-EOD OD/OB munitions debris (Figure 3-38d).



**3-38a.** A broad, unstable toe-of-slope sediment berm has formed at the perimeter of the stream



**3-38b.** Recent sediment flow into the stream has buried vegetation with approximately 5 inches of sediment



**3-38c.** Broad, braided stream channel caused by sedimentation



**3-38d.** EIA-1 munitions debris

### **Figure 3-38. EIA-1 Nonpoint Source Pollution and Stream Degradation**

Quantification of sediment impacts on the stream segments channel morphology and biological parameters and assessment of overall impacts to the Blount Mill Creek watershed would require additional analysis.

Assuming an average depth of soil loss to be 0.25 feet and a volume weight of 106 pounds of Lakeland soil per cubic foot, it is estimated that approximately 5,000 tons of soil have been displaced and transported downslope towards the stream. The estimated erosion rate for the site is 116 tons/acre/year. Unless treated, the site will continue to erode at accelerated rates.

The gullies will continue to headcut away from the stream, which could jeopardize the future use of the permitted OD/OB unit. New gullies will form as the stream slope continues to fail over time, and sediment loads will continue to be deposited within the stream segment. Ultimately, the capacity of the test area to support mission activities would be diminished, and there is the potential for the execution of a Notice of Violation or other regulatory action.

### **Oakie Creek Ridge Road (EIA-2)**

The unpaved test area road along the southern stream terrace ridge of Oakie Creek was poorly designed and maintained and as a result has become the source of several gullies and a primary contributor of gross amounts of sediment into the stream. The road provides access to TA C-62 targets TT-6 and TT-4 (Figure 3-34). Little or no consideration was given to the position of the target access road in relation to the stream slope crest or natural drainage patterns. EIA-2 covers ~6.8 acres.

In the absence of proper road construction and maintenance and implementation of erosion and runoff control practices, water flows intercepted by the road have resulted in severe erosion of the road and adjacent stream slopes of Oakie Creek. The loose sand and road fill material has been washed away exposing the relatively impermeable cemented soil of the underlying geologic formation. Unabated road erosion has lowered the road template below the grade of natural ground, which equates to a road functioning as a water channel (Figure 3-39).



**Figure 3-39. Primary Oakie Creek Ridge Road Erosion Site**

During storm events watershed drainage follows natural patterns towards stream outlets. The ridge road intersects these drainage areas and collects and concentrates water surface runoff flows. Once the collected water finds a point of least resistance along the stream slope, it increases in velocity and can create gullies that transport large amounts of sediment to streams (Figures 3-40a through 3-40f). The road is also the primary cause of the destruction of the archaeological site 8WL111 (Figure 3-40d). Degraded roads that serve as stormwater conduits also create potential direct routes



of transport that could expose aquatic systems to various types of chemical materials (particulate matter, metals, and other chemical residues) generated during mission events at nearby test targets.



**3-40a.** Active EIA-2 stream gully created by the ridge road site depicted in Figure 3-33



**3-40b.** Additional EIA-2 gully dissecting a stream slope of Oakie Creek



**3-40c.** Road/stream slope sediments are delivered directly into the Oakie Creek stream channel



**3-40d.** Destroyed archaeological site 8WL111



**3-40e.** Toe-of-slope sediment deposition fan at the headwaters of Oakie Creek



**3-40f.** Denuded Oakie Creek stream slope

**Figure 3-40. EIA-2 Landscape Degradation**

**Oakie Creek North Boundary RR 380 (EIA-3)**

EIA-3 is a ~10.6 acre site comprised of test area access road RR 380 and adjacent stream slopes that skirt the northern boundary of TA C-62 between the western control tower and the spotting tower to the east (Figure 3-34). Areas impacted by erosion include the roadway and stream slopes south of the road. There is a culvert crossing of a stream segment of Oakie Creek. Road slopes generally range between 2 percent and 8 percent.

The full length of the road has been surfaced with crushed limestone (Figure 3-41). The roadway and surrounding slopes are experiencing accelerated rates of soil erosion and sediments are being transported directly to receiving slopes and the Oakie Creek stream segment.

The erosion problems associated with EIA-3 stem from the absence of stormwater runoff management practices that:

- Transport runoff with non-erosive water conveyance systems
- Intercept and diffuse the erosive energy of runoff at predetermined intervals
- Transition water flows to non-erosive discharge points

Stormwater runoff contribution from the roadway and surrounding watershed are generally confined to an unprotected approximately 500 foot ditch on the south side of the road that serves as a sediment source and a sink (Figures 3-42a and 3-42b). A silt fence and hay bales have been improperly used as permanent sediment control structures at the channel outlet at the crest of a stream slope. High velocity channel flows and sediment loading long ago overwhelmed the collapsed silt fence and buried straw bales.



**Figure 3-41. North Boundary RR 380**



The photographs in Figures 3-42c and 3-42d exemplify the additional damage that has occurred at the roadside channel outfall over time. Since the roadside channel outfalls at the crest of the stream slope, water continues to collect and concentrate, which results in unabated erosion of the roadbed and stream slope. Drainage and sediment outfall is the stream segment at the toe-of-slope. The adjoining stream slopes have also experienced extensive erosion and soil loss (Figure 3-42e).

The road prism is generally configured to move water to the south side of the road in an efficient manner; however, there is no provision for the removal of water moving down the road slope. During storm events water follows prevalent road surface gradients. On relatively level road surfaces, water moves across the road without accumulating along the downslope gradients. However on long, moderate road slopes of EIA-3, the amount of water moving down as well as across the road slope can be substantial. Frequently the result is erosion of the road surface (Figure 3-42f).

The road design and maintenance erosion problems associated with EIA-3 are treated in the *Eglin Air Force Base Range Road Maintenance Handbook* (U.S. Air Force, 2001d) developed by SAIC for Civil Engineering. The handbook provides customized engineering design standards and ground application specifications for road reconstruction and treating erosion problems associated with typical problematic road conditions encountered on Eglin.



**3-42a.** Upslope view of the roadside ditch



**3-42b.** Downslope view of the roadside ditch



**3-42c.** Roadside ditch outfall January 2000



**3-42d.** Roadside ditch outfall August 2001



**3-42e.** Severely eroded roadside slope



**3-42f.** Eroded road surface caused by the accumulation of road down gradient water flows

**Figure 3-42. EIA-3 Range Road 380 Landscape Degradation**

#### **Burnout Creek Headwater (EIA-4)**

EIA-4 is a ~5 acre site located on the south side of aircraft gunnery strafing target TT-3 (Figure 3-34). Since construction, the aircraft gunnery impact area has been kept clear of vegetation to assist in pilot recognition and to expedite the recovery of munitions debris. Historically, specialized equipment was used to retrieve 20 mm and 30 mm debris in a manner similar to the recovery of golf balls at a driving range. The initial maintenance of a denuded target area promoted soil erosion along the downslope gradient toward the headwaters of Burnout Creek to the south (Figure 3-43).



**Figure 3-43. Overview of EIA-4 Gully and Burnout Creek Sediment Deposition Fan**



In the absence of runoff, erosion, and sediment control measures, the site has experienced years of unabated soil loss. Stormwater runoff has created three primary outlets that have evolved into active gullies (Figures 3-44a and 3-44b). Long-term erosion of the upslope surface of the target area watershed has evolved into a relatively impermeable layer that moves water in a manner similar to an asphalt parking lot (Figure 3-44c). In some locations the Critronelle geologic layer is exposed and has a density similar to coarse cement. In other areas, the silt content of remnant soils has been sufficient to produce a thin crust that resists water penetration.

The sediment deposition fan extends from the edge of the target area to the stream (Figures 3-44d, 3-44e, and 3-44f). Along some portions of the stream slope vegetation has been covered with an estimated two to four feet of sediment. The only vegetation not buried is woody species tall enough to remain exposed above the sediment and/or resistant to being toppled over by accumulating layers of sediment (Figure 3-44g). In some instances, there were isolated patches of pioneer grasses that exemplify the capacity of vegetation to resist the forces of erosion (Figure 3-44h).



**3-44a.** Gully along the southern edge of TT-3 that has been incised and again filled with sediment



**3-44b.** Primary runoff channel leading off the TT-3 watershed towards the headwater of Burnout Creek



**3-44c.** Barren "parking lot" like slopes of target TT-3



**3-44d.** Sediment deposition berms at the southern edge of TT-3



**3-44e.** Sediment bar encroachment of Burnout Creek headwaters



**3-44f.** Eight inch tall soil pedestal of panicgrass (*Dichanthelium* spp.) that continues to resist erosion. Grass roots are the only thing holding the soil underneath.



**3-44g.** Burnout Creek headwater toe-of-slope sediment deposition



**3-44h.** Buried stream slope vegetation

**Figure 3-44. EIA-4 Landscape Degradation**

### 3.4.6 Test Area Vegetation Maintenance

Bushhogging and roller drum chopping vegetation management techniques are currently used to keep TA C-62 clear of native vegetation. Of the 1,290 acres that comprise TA C-62, 1,163 acres are bushhogged and/or roller drum chopped (U.S. Air Force, 1999). Roller drum chopping causes a substantial amount of surface disturbance, whereas bushhogging disturbance is primarily limited to soil disturbance associated with wheel tracking. Traditionally roller drum choppers are used in forestry following timber harvesting to prepare a site for tree planting. Choppers are used to prepare a mineral seedbed for tree planting and control competing, undesirable woody vegetation.

A typical roller drum chopper consists of a set of three water-filled drums arranged in tandem and pulled by an eight-wheel drive 290 horsepower tractor. Each drum contains up to 12 blades arranged in a circle that measures 6 feet in diameter and weighs 5-8 tons (Figures 3-45 and 3-46). The roller drum blades chop into the soil an average of 6 inches.





Figure 3-45. Typical Roller Drum Chopper Rig



Figure 3-46. Roller Drum Choppers

The justification for the use of roller drum chopping on test areas is dense growth of fast growing woody species that could interfere with mission performance whether by interfering with instrument data collection, obstructing scoring, or impeding munitions recovery operations. The vegetation targeted as most problematic is fast growing hardwood species such as scrub oaks (turkey and bluejack oak), persimmon, live oak, and sand post oak and woody shrubs such as holly (*Ilex opaca*), dwarf huckleberry (*Gaylussacia dumosa*), gopher apple (*Licania michauxii*), and sumac (*Rhus* spp.). Areas of extensive woody growth may be consecutively roller drum chopped three to four times.

Roller drum chopping does not selectively remove problematic woody vegetation but damages all plant coverage. Ridges and swales created by drum choppers can persist for several years and may promote the erosive channel flow of water. The cutting blades of the chopper also sever and separate the root systems of native grasses and expose roots to potentially hot and/or dry conditions. In many instances the native cover of grasses and forbs is slow to recover from repeated chopping disturbance. The stressed vegetation is also susceptible to pathogen and parasite outbreaks.

### 3.4.7 Test Area Target Maintenance

The six target areas on TA C-62 are identified in Table 3-10, located on Figure 3-34, and described in the following narrative.

**Table 3-10. Test Area Targets**

Target	Latitude (North)	Longitude (West)	Authorized Deliveries	Authorized Ordnance
TT-1	30-38-34.233	86-13-37.078	DB, HADB, DTOSS, LALD, LAB, RX, HAS, VLD/RLD, VLADD/RLADD, ASRT beacon bomb, loft, and stabilized climb	BDU-33, MK-106, BDU-12, BDU-7, 2.75" RX (inert), 20 mm and 30 mm TP/TPT, and sensors
TT-3	30-39-13.976	86-14-34.868	—	20 mm and 30 mm TP/TPT
TT-4	—	—	DB, HADB, LALD, LAB, and loft	BDU-33, MK-106, MK-82 (inert), MK-84 (inert), and BLU-27 (inert)
TT-5 (Mobile)	—	—	DB, LALD, LAB, RX, HAS, VLD/RLD, and skip	BDU-33, MK-106, MK-82 (inert), MK-84 (inert), BLU-27 (inert) 2.75" RX (inert/WP), and 20 mm and 30 mm TP/TPT,
TT-6	30-38-55.9194	86-13-37.4562	DB, HADB, LALD, DTOSS, LAB, VLD/RLD, VLADD/RLADD, and loft	BDU-33, MK-106, and sensors
TT-7	30-39-06.350	86-13-42.666	—	—

DB=Dive Bomb, HADB=High Altitude Dive Bomb, DTOSS=Dive Toss, LALD=Low Angle Low Drag, LAB=Low Angle Bomb, RX=Rockets, HAS=High Angle Strafe, VLD/RLD=Visual/Radar Laydown, VLADD/RLADD=Visual/Radar Low Altitude Drogue Delivery, ASRT=Air Surveillance Radar Team  
Source: U.S. Air Force, 1996e

Target TT-1 is a scorable main bombing target consisting of a decommissioned tank target surrounded by four circles with a radius of 75, 150, 500, and 800 feet. There are four pairs of radar reflectors positioned north, south, east, and west at 1,500 feet from the target center. Timer reference points (TRP) are located 12,300 feet from the target center on the north approach, and 12,000 feet on the east and southeast approaches. There are three flight lines that are used by pilots for target approach. These approximately 15 foot wide flight lines are disked to maintain the visual recognition of bare soil against vegetative cover. The north flight line is approximately 12,177 feet long and is disked down the slope of Oakie Creek, but not through it. The inert BDU-33D/B is the ordnance most commonly expended at TT-1. Historically, the target area was disked following Civil Engineering Explosive Ordnance Disposal cleanup to provide visual aerial recognition of the target area.

Target TT-3 is a low angle strafing target used for high performance aircraft gunnery training. The target consists of four acoustic scoring systems located 2,000 feet from the foul line. Scoring pattern size is adjustable using the acoustical scoring system. The four targets consist of 20-foot F-4 drag chute panels suspended between telephone poles. Expendables primarily include 20 mm and 30 mm ammunition. During a mission event, an aircraft will typically fire between 200 and 300 rounds of 20 mm or 30 mm TP/TPT ammunition at a rate of 30 to 50 rounds per strafing run. Strafing is repeated until the aircraft "Winchesters" or runs out of ammunition. Historically, machinery was used to retrieve gunnery ammunition debris.

Target TT-4 is a scorable target consisting of a single truck located in a 225-foot radius circle near the east edge of the test area.

Target TT-5 is an unscorable tactical target consisting of four target vehicles that are moved to cleared and camouflaged areas as required. The expenditure of 2.75" white phosphorus rockets is restricted to TT-5. Target TT-5 is not used if winds exceed 15 knots because of the potential for starting wildfires.

Target TT-6 is a scorable circular target with a wooden pylon target in the center surrounded by two circles with a radius of 75 and 150 feet. The target may be used as a no-show target for radar nuclear deliveries using the TT-1 radar reflectors. In some directions, ground scoring is limited to 500 feet. Like TT-1, this target area was disked following CE-EOD cleanup to provide visual aerial recognition of the target area.

Target TT-7 consists of three vehicle mock-ups constructed of tin, which are located on the north slope of Oakie Creek. Target TT-7 has been used by Hurlburt's Air/Ground Operations School (AGOS) tracking team to train personnel in target acquisition.

### 3.4.8 Air Quality

The quality of air in a given location or region is generally described by the concentrations of various measurable substances known as "criteria pollutants." The concentrations of these pollutants are expressed in terms of parts per million (ppm), milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ), or micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Air quality is determined by the type and amount of pollutants in the atmosphere, the size and topography of the air basin, and the local and regional meteorological influences.

Identifying the affected area for an air quality assessment requires knowledge of pollutant types, source emissions rates and release parameters, proximity relationships of project emission sources to other emissions sources, and local and regional meteorological conditions. For inert pollutants (those that do not participate in photochemical reactions; i.e., all pollutants other than ozone and its precursors), the affected area is generally limited to an area extending a few miles downwind from the source. Pollutant concentrations are compared to federal and state ambient air quality standards to determine potential affects. These standards represent the maximum allowable atmospheric concentration that may occur and still protect public health and welfare, with a reasonable margin of safety. The national ambient air quality standards (NAAQS) are established by the U.S. Environmental Protection Agency (USEPA).

In order to protect public health and welfare, the USEPA has developed numerical concentration-based standards or NAAQS for six "criteria" pollutants (based on health related criteria) under the provisions of the Clean Air Act Amendments of 1970 (CAA). There are two kinds of NAAQS, primary and secondary standards. Primary standards prescribe the maximum permissible concentration in the ambient air to protect public health including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards prescribe the maximum concentration or level of air quality required to protect public welfare including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

National ambient air quality standards have been established for: 1) ozone, 2) nitrogen dioxide, 3) carbon monoxide, 4) sulfur oxides, 5) lead, and 6) particulate matter with an aerodynamic diameter less than or equal to 10 microns (Table 3-11). The NAAQS are the cornerstone of the CAA. Although not directly enforceable, they are the benchmark for the establishment of emission limitations by the states for the pollutants that USEPA determines may endanger public health or welfare.

**Table 3-11. National and Florida Ambient Air Quality Standards**

Criteria Pollutant	Averaging Time	Primary Standard <sup>1,2,3</sup>	Secondary Standard <sup>1,2,4</sup>	Florida Standards
Carbon Monoxide	8-hour	10 mg/m <sup>3</sup>	No standard	10 mg/m <sup>3</sup>
	1-hour	40 mg/m <sup>3</sup>	No standard	40 mg/m <sup>3</sup>
Lead	Quarterly	1.5 µg/m <sup>3</sup>	1.5 µg/m <sup>3</sup>	1.5 µg/m <sup>3</sup>
Nitrogen Dioxide	Annual	100 µg/m <sup>3</sup>	100 µg/m <sup>3</sup>	100 µg/m <sup>3</sup>
Ozone	1-hour <sup>5</sup>	235 µg/m <sup>3</sup>	235 µg/m <sup>3</sup>	235 µg/m <sup>3</sup>
	8-hour <sup>6</sup>	157 µg/m <sup>3</sup>	157 µg/m <sup>3</sup>	157 µg/m <sup>3</sup>
PM <sub>10</sub>	Annual	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>
	24-hour <sup>7</sup>	150 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>
PM <sub>2.5</sub>	Annual	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
	24-hour <sup>8</sup>	65 µg/m <sup>3</sup>	65 µg/m <sup>3</sup>	65 µg/m <sup>3</sup>
Sulfur Oxides (SO <sub>2</sub> )	Annual	80 µg/m <sup>3</sup>	No standard	60 µg/m <sup>3</sup>
	24-hour	365 µg/m <sup>3</sup>	No standard	260 µg/m <sup>3</sup>
	3-hour	No standard	1,300 µg/m <sup>3</sup>	1,300 µg/m <sup>3</sup>

Sources: Clean Air Act, 42 U.S.C. 7401 et seq.; Official Compilation of the Rules and Regulations of the State of Florida; Title 62 - Department of Environmental Protection, Chapter 62-272 - Air Pollution, Part III, Ambient Air Quality; MMS, 1990; U.S. Air Force, 1998.

1. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year.
2. Concentration expressed first in units in which it was promulgated.
3. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
4. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
5. The ozone 1-hour standard still applies to areas that were designated nonattainment when the ozone 8-hour standard was adopted in July 1997.
6. The ozone 8-hour standard is attained when the fourth highest 8-hour concentration in a year, averaged over three years, is equal to or less than the standard.
7. The PM<sub>10</sub> 24-hour standard is attained when 99 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.
8. The PM<sub>2.5</sub> 24-hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.

Florida has adopted the NAAQS except for sulfur dioxide (SO<sub>2</sub>). USEPA has set the annual and 24-hour standards for SO<sub>2</sub> at 0.03 ppm (80 micrograms per cubic meter [µg/m<sup>3</sup>]) and 0.14 ppm (365 µg/m<sup>3</sup>) respectively. Florida has adopted the more stringent annual and 24-hour standards of 0.02 ppm (60 µg/m<sup>3</sup>) and 0.01 ppm (260 µg/m<sup>3</sup>) respectively. In addition, Florida has adopted the national secondary standard of 0.50 ppm (1,300 µg/m<sup>3</sup>)

The fundamental method by which the USEPA tracks compliance with the NAAQS is the designation of a particular region as “attainment,” “nonattainment,” or “unclassifiable.” Areas meeting or having better air quality than the NAAQS are said to be in attainment. Areas that exceed the NAAQS are said to be in nonattainment. Areas that cannot be classified on the basis of available information as attainment or nonattainment are defined as unclassifiable and are treated as attainment areas. Attainment areas can be further classified as maintenance areas. Maintenance areas are areas that were previously nonattainment but have reduced pollutant concentrations below the standard and must maintain some of the nonattainment area plans to stay in compliance.

TA C-62 potential sources of air emissions include CE-EOD OB/OD operations, wildfires, and prescribed burning of adjacent Pine Sandhills. Open burning is characterized as a continuous type release because of the 4 to 8 hour duration of the event, whereas open detonations are characterized as a semi-instantaneous puff type release. An illustration of a typical detonation event is presented in Figure 3-47.



**3-47a.** Thermal degradation flash and radiant heat milliseconds after ignition of energetic materials



**3-47b.** Air entrained materials begin to form a puff cloud



**3-47c.** Buoyant puff cloud of dust, gases, and particulate matter begins to rise



**3-47d.** Final puff phase cloud created within 10 seconds of the detonation

**Figure 3-47. Illustration of a Typical Detonation Event**

## 4. ENVIRONMENTAL CONSEQUENCES

### 4.1 INTRODUCTION

The purpose of this chapter is to analyze the potential impacts of current mission effectors (Chapter 2) on the TA C-62 affected environment receptors (Chapter 3). The objective is to identify and characterize, at the landscape level, the nature and possible consequences of this cause-effect relationship. This layer of data will identify effector-receptor linkages and create a quantifiable measure of potential environmental impacts. This section identifies environmental issues associated with the baseline described in Chapter 2 and quantifies these issues using units of measurement called metrics. The environmental analysis process is described as follows.

#### 4.1.1 Organization

For the environmental analysis, the military mission and support activities are divided into the following categories:

- Air-to-Surface Bomb Testing and Delivery Training
- High Performance Aircraft Gunnery Training
- Shoulder-Launched M190 Missile and Light Anti-Tank Weapon System (LAWS) Rocket Training Ground Operations
- Civil Engineering Explosive Ordnance Disposal (CE-EOD) Open Detonation Operations
- UXO Detection Testing
- Test Area Target Maintenance
- Test Area Vegetation Maintenance
- Test Area Roads

The TA C-62 military mission targets and training areas are presented in Figure 4-1.

Issues are the general categories used to distinguish the potential environmental impacts of the effectors on the receptors. Specifically, an issue is a mission effector product, by-product, and/or emission that may directly or indirectly impact the physical, biological and/or cultural environmental receptors. A direct impact is a distinguishable, evident link between an action and the potential impact, whereas an indirect impact may occur later in time and/or may result from a direct impact. The four issues identified for analysis screening include noise, habitat alteration, direct physical impact, and chemical materials.

#### Noise

Noise in this document is defined as the unwanted sound produced by munitions testing and training mission activities. Noise may directly inconvenience and/or stress humans and some wildlife species and may cause hearing loss or damage. Scientific data correlating the effects of noise on humans is well documented; however, information regarding the effects of noise events on wildlife species is limited. The impacts of noise on the public and on wildlife, particularly threatened and endangered species, are a primary concern. The mission noise event of potential consequence to the environment is the CE-EOD open detonation operations.



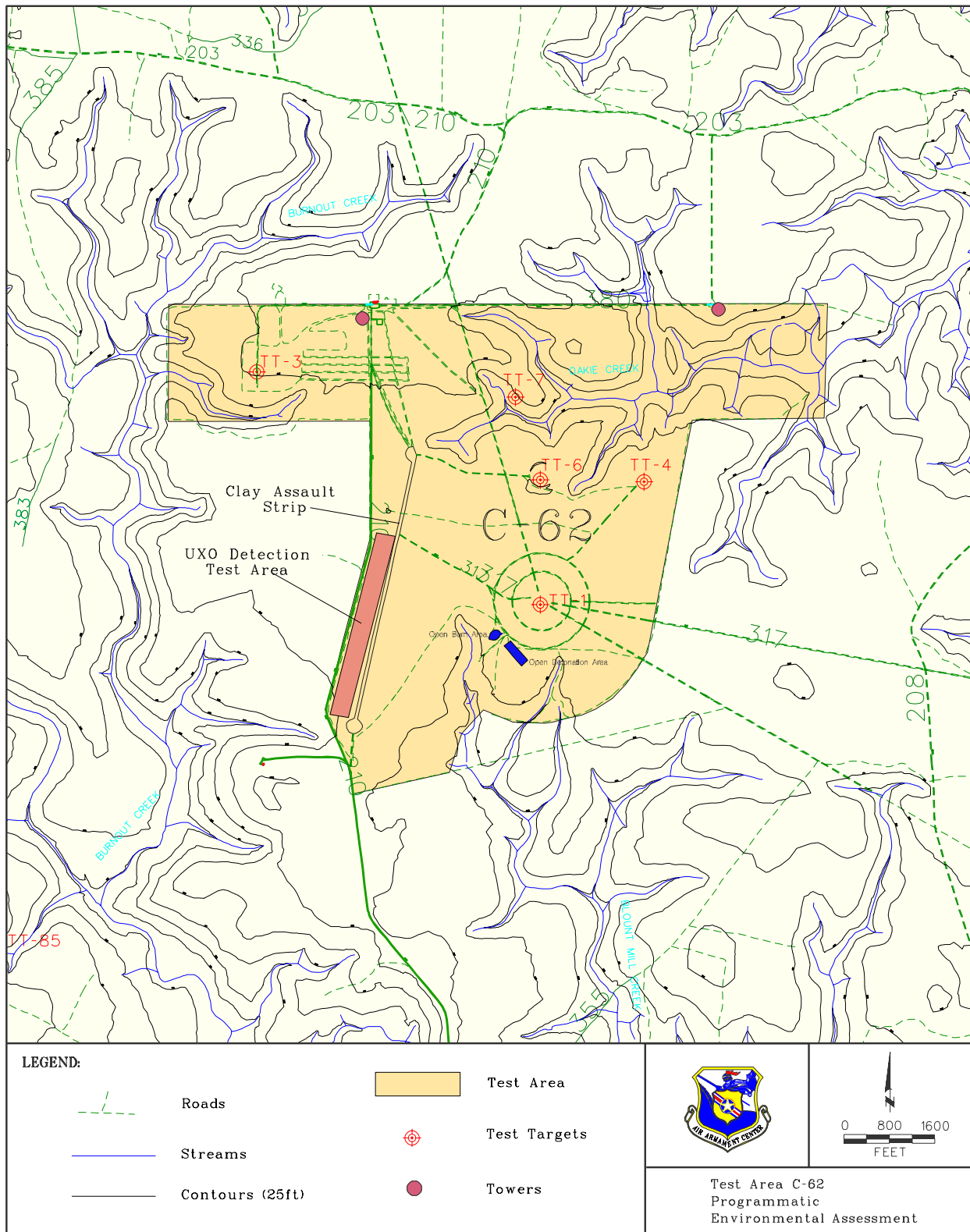


Figure 4-1. TA C-62 Features and Target Areas

## Habitat Alteration

Habitat alterations characterize the physical damage, stress, or disruptions that may adversely alter or degrade the habitats of TA C-62. A habitat in this instance refers to the ecologic and geomorphologic components that support organisms such as vegetation, soil, topography, and water. Subsequent degradation of unique and diverse habitats may impact sensitive species. Examples of habitat alteration include soil erosion, sedimentation of aquatic habitats, physical changes in topography, wildfires, and physical stress, injury, or mortality to the biological components of habitats. The mission activities of potential consequence to the habitats of TA C-62 include:

- Air-to-Surface Bomb Testing and Delivery Training
- High Performance Aircraft Gunnery Training
- Shoulder-Launched M190 Missile and LAWS Rocket Training Ground Operations
- CE-EOD Open Detonation Operations
- UXO Detection Testing
- Test Area Target Maintenance
- Test Area Vegetation Maintenance
- Test Area Roads

## Direct Physical Impact

Direct physical impact is the physical harm that can occur to an organism (plant or animal) or cultural resource as a result of mission activities. Examples include aircraft collisions with birds, vehicle-animal road collisions, crushing an organism by vehicle or foot traffic, and ordnance shrapnel or debris striking an organism. Direct physical impact is also a threat to prehistoric and historic cultural features; significant features, structures, artifacts, and site integrity may be damaged or lost due to physical disruptions. The mission activities of potential consequence to direct physical impacts on TA C-62 include:

- Air-to-Surface Bomb Testing and Delivery Training
- High Performance Aircraft Gunnery Training
- Shoulder-Launched M190 Missile and LAWS Rocket Training Ground Operations
- CE-EOD Open Detonation Operations
- Test Area Vegetation Maintenance
- Test Area Roads

## Chemical Materials

Chemical materials encompass liquid, solid, or gaseous substances that are released to the environment as a result of mission activities. These include organic and inorganic materials that

can produce a chemical change or toxicological effect to an environmental receptor. Examples include gaseous air emissions (aircraft exhausts, smokes, combustion products of explosives), liquid materials (fuels and pesticides), and solid materials such as metals from ordnance and ammunition expenditures (zinc, copper, aluminum, and lead). The by-products of ordnance expenditures could potentially contaminate soil or underlying groundwater, and/or affect air quality. The chemical material by-products generated by CE-EOD open detonation operations are identified as the mission activity having potential chemical materials impacts to the environment of TA C-62.

## Debris

Debris is a physical by-product of military testing or training deposited on the surface, partially buried, or buried in the soil on impact. Debris is inclusive of inert non-hazardous materials on the surface analogous to litter and potentially hazardous surface and subsurface unexploded ordnance (UXO). Debris includes items such as shrapnel, spent casings, bomb fragments, UXO, and target or structure fragments. Depending on the composition, debris may become a chemical materials issue, or it may have human safety or aesthetic impacts. The baseline mission activities of potential consequence to debris on TA C-62 include:

- Air-to-Surface Bomb Delivery Training
- High Performance Aircraft Gunnery Training
- Missile and Rocket Ground Training Operations
- Civil Engineering Explosive Ordnance Disposal

Of particular concern to this analysis are the heavy surface accumulation of inert and UXO debris and the potential chemical material impacts of historic subsurface UXO.

### 4.1.2 Process

Each military activity category was associated with potential issues related to the activity as described in Table 4-1.

**Table 4-1. Summary of Mission Effectors and Associated Issues**

EFFECTORS	ISSUES				
	Noise	Habitat Alteration	Direct Physical Impact	Chemical Materials	Debris
Air-to-Surface Inert Bomb Testing and Delivery Training	—	●	●	—	●
High Performance Aircraft Gunnery Training	—	●	●	—	●
Shoulder-Launched M190 Missile and LAWS Rocket Training Ground Operations	—	√	●	—	●
CE-EOD OB/OD Operations	●	●	●	●	●
UXO Detection Testing	—	√	—	—	—
Test Area Target Maintenance	—	●	—	—	√
Test Area Maintenance	—	●	●	—	—
Test Area Roads	—	●	√	—	—

● Potential impact      √ Minimal potential impact      — No potential impact

For each issue category, the mission activities are identified and environmental analysis is performed.

### Mission Activities

Each mission activity is identified and baseline data for the years FY95, FY96, and/or FY97 are referenced or briefly discussed. The mission expenditure baseline was developed for each TA C-62 mission category using expenditure data from FY95 through FY97. For each mission category, the maximum annual number of expenditures among the three years was used as the baseline. The purpose is to provide a benchmark for evaluating current and future mission activity levels.

### Environmental Analysis

The environmental analysis quantifies the issues impacting the receptors identified in the Affected Environment (Chapter 3). The TA C-62 receptors include physical resources (soil, water and air quality), biological resources (sensitive habitats and wildlife), and anthropogenic (public and cultural resources).

An important military mission concept that coincides with this environmental consequences analysis is the need for land specifically reserved for military mission testing and training. As such, TA C-62 is a land area that has a specific land use designation that is crucial to the support of the National Security and Military Strategy of the Department of Defense (U.S. Department of Defense, 1999). The weapon systems training activities performed at TA C-62 is critical to building, maintaining, and improving the defense readiness of the United States military forces. It is important to understand that the scope of the environmental analysis does not include an assessment of the TA C-62 land use designation.

The weapons system training that is and will continue to be performed on TA C-62 is, by its nature, prone to generate impacts that may affect the environment within the region of influence of TA C-62. That is the focus of this analysis. Receptors that are potentially impacted by each issue are listed in Table 4-2.

**Table 4-2. Summary of TA C-62 Receptors Potentially Impacted by Issues**

RECEPTOR	ISSUES				
	Noise	Habitat Alteration	Direct Physical Impact	Chemical Materials	Debris
<b>Physical Resources</b>					
Soil Quality	—	●	●	●	●
Water Quality	—	●	●	●	●
Air Quality	—	—	—	●	—
<b>Biological Resources</b>					
Sensitive Habitats	—	●	√	●	√
Sensitive Wildlife	●	●	●	●	√
<b>Anthropogenic</b>					
Public	●	—	—	—	—
Cultural Resources	—	●	●	—	—

● Potential impact

√ Minimal potential impact

— No potential impact

The analysis produces a measure for each issue that can be used for comparison when considering the alternatives. The discussion of the measures includes criteria to analyze the impact of the issue, if criteria are available. If criteria are not available, the discussion is based on what is known in the literature about impacts related to the issue. An example of this procedure is quantifying the level of noise (issue) at gun firing areas and discussing impacts on the red-cockaded woodpecker (receptor). Measures were frequently derived from maps of the affected environment with overlays of the distribution and intensity of the training activity.

For the environmental analysis on TA C-62, a conservative scenario method of analysis is utilized. Assumptions are formulated to reflect the behavior, condition, and/or interactions of mission effectors and receptors. Scenario assumptions are based on a combination of scientific data and established methods, interviews with experts and mission personnel, and best professional judgments. As an example, a noise contour model is used to generate a GIS map that estimates the extent of noise generated by CE-EOD open detonation events under favorable and unfavorable weather conditions, whereas the assessment of TA C-62 air-to-surface inert bomb training impact potentials on sensitive species and gopher tortoise burrow habitats is based on mission and bomb footprint parameters and biological data.

The *Effector Analysis Report*, or EAR, (U.S. Air Force, 1996d) is referenced as part of the environmental analysis performed for this chapter. As stated in the introduction, the EAR was developed to serve as a comprehensive reference for the environmental effects of the Eglin expendables on the Eglin environment. The EAR is a detailed analysis that is based on a compendium of over 300 references. Many of the conclusions derived in this report were analyzed in detail in the EAR. The analysis used in this chapter summarizes the information from the EAR and elaborates on the issues that need discussion. A reference to the EAR is not one reference in and of itself, but a comprehensive assortment of references.

#### 4.1.3 Range Sustainability

Under the regulatory framework of the Department of Defense (DoD) Munitions Rule (Federal Register, 1997), there is emphasis on incorporating the virtues of range sustainability into military mission operations. In the broadest sense, sustainability refers to the ability of an organization, society, ecosystem, or other ongoing system to continue functioning into the indefinite future, without being forced into decline through exhaustion or overloading of key resources on which that system depends. The functional premise of TA C-62 range sustainability is that present mission needs are being met without compromising the capability of the test area to support future mission needs.

Sustaining the mission is generally defined as a systematic and cooperative approach to protecting socioeconomic and environmental concerns over the long term. From a military mission perspective, sustainability is viewed within the context of indefinite support of live, realistic warfighter testing and training missions by sustaining the mission servicing capacity of the environment. As an example, a failure to support the functioning of ecosystems could ultimately result in the failure of test areas to support military missions. Unabated soil erosion can destabilize and remove the land surface on which mission activities depend. Since the days of constructing new land test areas have all but passed, it is crucial that steps be taken to protect and conserve what already exists.

It is the intention of the DoD to demonstrate that it is a responsible, accountable, and capable resource management steward by extending beyond traditional compliance perspectives and developing proactive policies and procedures that embrace ecosystem management from an integrated natural resources perspective. DoD is faced with a diversity of issues contributing to the complexity of operating and sustaining a test area including health and safety risks, environmental risks, maintenance challenges, and military mission restrictions. Factors that have been instrumental in the evolving changes in future requirements for military testing and training areas include:

- DoD downsizing has resulted in the closure of military bases and relinquishment of testing and training areas.
- There have been significant advances in weapon system capabilities. In many instances modern warfighting tactics require substantially larger training spaces compared to 20 years ago.
- Modern weapons and sensors allow longer engagements, increasing the demand for testing and training space. Jointly, there is greater socioeconomic pressures to limit space that is currently available. Partial relief comes from the increased flexibility of modern instrumentation.
- In some instances the growth in environmental legislation has posed a challenge to maintaining the ability of DoD to train and exercise weapons capability.

Actions that are incompatible with mission sustainability could occur as a result of abandonment of test areas because of safety concerns associated with heavy loads of UXO, presence of toxic materials at concentrations that exceed regulatory thresholds, or deterioration of the land surface by erosion. There have been instances of regulators forcing DoD to curtail mission activities. In 1995, the U.S. Environmental Protection Agency fined the Massachusetts Military Reservation \$221,059 and curtailed some mission activities because of violations pertaining to improper hazardous waste handling and the National Guard Bureau committed to pay \$555,000 for failure to meet established deadlines for submittal of project documents under the Federal Facilities Agreement (USEPA, 1996).

### **Environmental Sustainability**

The goal of environmental sustainability is to indefinitely sustain life-support systems and improve biological welfare by protecting the source and service capabilities of natural resource base components such as air, water, and soil. Implementation of this goal requires that humans operate within the limitations of the biophysical environment in using the environment as a source of inputs and a sink for wastes. Overuse of a resource service capacity impairs its provision of life-support services. For example, accelerated soil erosion compromises the biological integrity of the soil environment and degrades water quality. As a result, land productivity is diminished and water consumption and use is limited. Environmental source and sink functions must be maintained unimpaired during the period over which environmental sustainability is required. The three basic principles of environmental sustainability are as follows:

1. Activity waste emissions should be kept within the assimilative capacity of the local environment without unacceptable degradation of its future waste absorptive capacity or other important services.
2. Removal rates of renewable resource components should be within the regenerative capabilities of the natural system that generates them.
3. Depletion rates of nonrenewable resource inputs should be set below the rate at which renewable substitutes are developed (Goodland, 1998).

Natural (land, fish, wildlife, biota, and surface water and groundwater) and cultural (historic and prehistoric) resources are subject to injury from the performance of test area mission activities. For the purpose of this analysis, resource injury is defined as a measurable change in the chemical or physical quality or viability of the resource resulting directly or indirectly from a test area mission activity, its by-products, and/or support systems, which degrades the mission support, value, and/or ecological function(s) that the resource provides.

### **Soil Environment**

Military missions performed on TA C-62 are executed on land that is required to service a diverse array of land surface disruptions and physical and chemical alterations. The test area landscape that is shared with various plants and animals is directly or indirectly affected by mission activities. The test area landscape, namely the soil environment, serves as the physical support that partly defines the mission support capabilities. The biological stability of the landscape defines the servicing capacity beyond which the capabilities of the soil environment to absorb and recover from mission impacts will be diminished. As the quality of the soil environment declines, adverse impacts to the performance of military missions and on- and off-site natural and socioeconomic resources will increase.

Maintaining a high quality soil environment requires a proactive approach to sustain plant and animal productivity, maintain and enhance water quality, and support organism health and habitation. General functions of the soil environment on TA C-62 include:

- Provide support for military mission structures and activities
- Sustain biological activity, diversity, productivity
- Regulate and partition water and solute flow
- Filter, buffer, degrade, immobilize, and detoxify organic and inorganic materials and by-products deposited by mission expenditures and activities
- Store and cycle nutrients and other elements

Of particular importance to TA C-62 range sustainability is the protection of the soil and water environment. As has been documented in Chapter 3, the four Erosion Impact Areas have drastically altered the physical condition of the test area mission activity landscape. Mission activity related sedimentation of test area streams has been documented. Potential soil and groundwater contamination associated with UXO and CE-EOD OB/OD operations is also a concern.

TA C-62 UXO contamination and Erosion Impact Areas are characterized in Section 3.4, Anthropogenic. Potential range sustainability impacts of soil erosion are analyzed in Section 4.3, Habitat Alteration, and potential chemical material and debris impacts of CE-EOD OD/OB operations and UXO contamination are presented in Section 4.5, Chemical Materials and Debris.

## 4.2 NOISE

The single-event noise generated on TA C-62 by the open detonation of live ordnance by CE-EOD is of potential consequence to the test area environment and areas extending beyond the reservation boundaries. Noise from munitions testing and training performed on Eglin has been a source of complaints by local residents (U.S. Air Force, 1996g). In the following sections, the noise sources and the disturbance dose of expenditures for the baseline period FY95 through FY97 will be defined, quantified, mapped, and evaluated with regard to impacts that may be incurred by human and biological receptors. In addition to potential impacts to humans and personal property, impacts to sensitive species are considered pursuant to the Endangered Species Act.

### 4.2.1 Alternative 1 (No Action) and 2 (Authorize Current Level of Activity)

Alternative 1 reflects the current level of mission activities for the Fiscal Year (FY) 95, FY96, and FY97 baseline period. Alternative 2 authorizes the baseline level of mission activities of Alternative 1 and provides for a comprehensive evaluation of the cumulative effects of current mission activities on TA B-75. Since Alternative 2 does not alter the mission activities associated with Alternative 1, the alternatives will be evaluated jointly for noise events.

The CE-EOD area in the southern portion of TA C-62 supports open-burn (OB) and open detonation (OD) ordnance disposal activities (Figure 4-1, page 4-2). There are two metal containers (called “kettles”) the size of large dumpsters that are used to open-burn munition materials. OB operations were first performed in 1998; therefore, no baseline expenditure data were available. For the baseline period FY95 through FY97, disposal of high-explosive ordnance was performed in open detonation pits (Figure 4-1). The baseline OD expenditures are summarized in Table 4-3.

**Table 4-3. Civil Engineering Explosive Ordnance Disposal Open Detonation  
Mission Expenditure Summary**

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW* (pounds)
Small Arms Ammunition	.38 Cal SP Ball	FY96	1,102	0.00
	.50 Cal AP	FY97	1	0.00
	.50 Cal API	FY96	304	0.00
	5.56-mm Ball	FY96	58,889	0.00
	5.56-mm Blanks	FY96	392	0.00
	7.62-mm Ball	FY95	733	0.00
	7.62-mm Blanks	FY97	155	0.00
	<b>Subtotal</b>		<b>61,576</b>	<b>0.00</b>

\*NEW = Net Explosive Weight (pounds)

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**Table 4-3. Civil Engineering Explosive Ordnance Disposal Open Detonation  
Mission Expenditure Summary Cont'd**

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW* (pounds)
Missile	Smokey Sam Rocket Motor	FY97	297	0.00
	2.75 Inch Rocket Motor	FY97	126	0.00
	<b>Subtotal</b>		<b>423</b>	<b>0.00</b>
Gun Ammunition	20 mm TP	FY97	3,664	0.00
	20 mm HEI	FY97	7	0.20
	25 mm TP	FY96	270	0.00
	30 mm HEI (PGU-13/B)	FY97	649	66.13
	30 mm TP (PGU-15/B)	FY96	7,139	0.00
	40 m HEI (PGU-9/B)	FY97	28	24.36
	40 mm AP M81A1	FY96	156	112.32
	57 mm CTG, HE	FY97	6	8.49
	105 mm HE	FY96	1	15.70
	115 mm Live	FY96	4	14.90
	<b>Subtotal</b>		<b>11,924</b>	<b>242.10</b>
Bombs	BDU-33	FY96	1,500	124.50
	BLU-107 Durandall Live	FY97	11	880.00
	BLU-108 Submunition CBU-97 Live	FY96	80	80.00
	BLU-109, Inert	FY96	600	0.00
	BLU-110A/B, Live	FY96	1	445.00
	MK-82, Live	FY96	6	1,152.00
	MK-82 GP, Inert	FY97	4	0.00
	MK-83, Inert	FY97	1	0.00
	MK-84, Live	FY97	1	945.00
	MK-84 LD, Inert	FY97	3	0.00
	Pipe Bomb	FY96	2	200.00
	Samanta Submunitions Motor	FY97	1	0.00
	<b>Subtotal</b>		<b>2,210</b>	<b>3,826.50</b>
Flares	Distress Flare	FY97	131	10.64
	LUU-2	FY97	1	22.00
	M-206	FY97	5	1.43
	MK-6	FY96	9	36.00
	MK-25	FY97	15	30.00
	Mk-58	FY96	1	4.85
	MJU-7	FY96	41	25.74
	MJU-10	FY97	114	228.00
	<b>Subtotal</b>		<b>317</b>	<b>358.66</b>

\*NEW = Net Explosive Weight (pounds)

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**Table 4-3. Civil Engineering Explosive Ordnance Disposal Open Detonation  
Mission Expenditure Summary Cont'd**

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW* (pounds)
Smoke	Smoke Grenades, M18	FY97	23	16.56
	MK-13 Marine Signal	FY96	120	25.44
	Smoke Pot	FY97	60	1,920.00
	<b>Subtotal</b>		<b>203</b>	<b>1,962.00</b>
C-4 (lb.)	5 lbs. HE	FY96	471	2,355.00
	1 lb. HE	FY97	60	60.00
	<b>Subtotal</b>		<b>531</b>	<b>2,415.00</b>
Propellant (lb.)	M-30	FY96	2,555	0.00
	1 Pound	FY97	1,412	0.00
	<b>Subtotal</b>		<b>3,967</b>	<b>0.00</b>
Explosives (lb.)	Black Powder (lbs.)	FY97	40	40.00
	Waste Explosives	FY96	10	10.00
	Waste Explosive, HERD (lbs.)	FY97	3,356	3,356.00
	OCTOL	FY97	44	44.00
	Comp. B HE, (lbs.)	FY97	113	113.00
	<b>Subtotal</b>		<b>3,563</b>	<b>3,563.00</b>
Explosive Sheets	Sheets	FY96	1	20.00
	Detasheets®	FY96	175	282.00
	<b>Subtotal</b>		<b>176</b>	<b>302.00</b>
Charge	Demo	FY95	2	2.00
	Demo M-112	FY95	5,882	7,352.50
	Demo M-183	FY95	40	800.00
	Demo TNT	FY95	662	3,310.00
	Demo 1.25 lbs HE	FY96	3,000	3,750.00
	Demo 5 lbs. HE	FY97	100	500.00
	<b>Subtotal</b>		<b>9,686</b>	<b>15,714.50</b>
Fuze	M-505	FY96	44	39.29
	MK-407	FY96	151	305.62
	FMU-124	FY96	77	20.88
	FMU-124A/B	FY97	1	0.27
	FMU-135/B	FY96	4	7.88
	FMU-139A/B	FY96	4	1.11
	FMU-143B/A	FY97	4	1.08
	FMU-153	FY96	17	13.11
	Blasting Time	FY95	2,898	7.82
	FZU-1/B Booster	FY95	41	0.41
	<b>Subtotal</b>		<b>3,241</b>	<b>397.47</b>
Blasting Cap	Electric M	FY95	53	0.15
	NON-EL	FY95	463	1.25
	<b>Subtotal</b>		<b>516</b>	<b>1.40</b>

\*NEW = Net Explosive Weight (pounds)

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**Table 4-3. Civil Engineering Explosive Ordnance Disposal Open Detonation  
Mission Expenditure Summary Cont'd**

Mission		Expenditure		
Munitions Category	Munitions Type	Fiscal Year	Number	Total NEW* (pounds)
<b>Detonator</b>	IDT-199	FY96	149	1.86
	RP-1	FY97	153	0.20
	<b>Subtotal</b>		<b>302</b>	<b>2.06</b>
<b>Detonation Cord (feet)</b>	Cord (feet)	FY5	8,482	78.88
	MK-120	FY97	72,400	7.24
	MK-140	FY96	333	14.65
	MK-143	FY96	190	16.25
	MK-149	FY96	48	37.02
	<b>Subtotal</b>		<b>81,453</b>	<b>154.04</b>
<b>Impulse Cartridge</b>	BBU-35	FY96	136	0.11
	BBU-36	FY97	192	0.42
	MK-2	FY96	44	0.61
	MK-9	FY96	525	9.82
	Squib RR-136	FY96	396	0.59
	MK-2 MOD 1	FY97	134	1.86
	<b>Subtotal</b>		<b>1,427</b>	<b>13.41</b>
<b>Other</b>	CTG Cal .50 AP M2	FY95	98	3.32
	CTG, Impul. .50 Cal.	FY97	40	0.97
	Time Igniter	FY95	330	0.03
	ARD-446 Squib	FY97	4,289	118.38
	ARD-863 Squib	FY96	289	2.60
	Primer, M-23A2	FY96	11,127	16.69
	Booster MK-339	FY96	68	709.38
	GND Burst SIM	FY96	2,998	422.72
	Reactive Armor	FY97	119	253.18
	Terminal Battery	FY97	33	0.00
	<b>Subtotal</b>		<b>19,391</b>	<b>1,527.27</b>
<b>Total</b>				<b>30,437.00</b>

\* NEW = Net Explosive Weight (pounds)

As illustrated in Table 4-3, TA C-62 was used extensively during the baseline period for CE-EOD open detonation disposal operations with FY96 being the year of heaviest use. During open detonation activities, explosive materials such as small arms ammunition, gun warheads, bombs, rocket and missile motors, propellants, smoke, flares, missile motors, and other types of explosive materials are placed in pits and detonated with C-4. The MK-84 (945 pounds NEW) bomb open detonated during FY97 was the highest explosive ordnance item included in CE-EOD disposal operations on TA C-62 (Appendix D). For the baseline period, approximately 30,437 lb NEW of explosive materials were burned or detonated in the CE-EOD pit area on the southern portion of the test area (Figure 4-1).

An open detonation is initiated by an Ammunition Disposal Requisition (ADR) submission to CE-EOD. The materials typically designated for disposal include ordnance that has exceeded its shelf life or requires disposal for safety reasons. Based on communications with CE-EOD personnel, an average ADR disposal for TA C-62 is 5,000 lb NEW of explosive materials. Since the maximum allowable single-event for an open detonation is 3,000 pounds of high explosives

(includes C-4 detonation charges), an ADR for 5,000 pounds of explosive would be divided into two 2,500 pound detonation events.

The CE-EOD open detonation events are characterized as high-order, high-yield explosions and not low-yield deflagration events as preferred by the Navy EOD School training operations. It is assumed that the expenditure of 2,500 pounds of explosive materials during a mission event would produce supersonic thermal combustion, minimum unexploded material, and maximum noise contour overpressures.

### **Environmental Analysis**

For the purpose of this analysis, noise is the undesirable sound disturbance that adversely impacts the normal behavior or well being of public and biological receptors or causes physical damage to cultural features. The scope of this environmental analysis process is based on evaluating the potential for noise generated by mission activities (effectors) to impact the public sector and biological and cultural resources (receptors) associated with TA C-62. This section identifies the criteria and methods for measuring noise impacts, identifies receptors and/or circumstances of special concern, and evaluates the potential environmental consequences of the various mission activities performed on TA C-62.

### ***Noise Event Metrics***

The recommended single-impulse noise event metric for high explosives is the dBP, unweighted peak sound pressure level. Threshold sound level metrics that reflect potential human annoyance and alteration in wildlife behavior are calculated and analyzed for the baseline TA C-62 mission activities. Special emphasis will be placed on evaluating the impacts of ground-based noise disturbance on sensitive species reproduction and nesting success that may impact the short-term welfare and long-term survivability of sensitive species.

Noise criteria may be health, safety, or annoyance related. The acoustic thresholds for humans as presented in Table 4-4 serve as a baseline for evaluating the impact potentials of noise events.

For safety reasons, the Eglin Safety Office stipulates that noise of 140 dBP should not leave the range since this is the maximum safe exposure level for humans without ear protection. This conservative human criterion is based on exposure to 100 continuous 140 dBP noise events. Environmental impact analysis must also take into account the fluctuations in the extent and magnitude of sound pressure waves introduced by changes in the weather. Variations in meteorological conditions such as changes in wind speed and temperature inversions have a distinct influence on the behavior of sound as it moves through the atmosphere. These meteorological variables may concentrate or focus sound waves in a particular direction or reflect or refract sound energy. The result is potentially high sound pressure levels far from the noise source that may vary by 30 dBP or greater at 20 miles or less (U.S. Air Force, 1996g).

**Table 4-4. Acoustic Thresholds for Humans**

Sound Pressure Level (dBP)	Overpressure (psi)	Threshold of Concern
20		No sound perceived
25		Hearing threshold
35		Slight sleep interference
50		Moderate sleep interference
55		Mild annoyance
60		Normal speech level
65		Communication interference
70		Smooth muscles and glands react
80		Moderate hearing damage
85		Very annoying
90		Affect mental and motor behavior
95		Potential hearing damage
115		Maximum vocal effort
125		Pain threshold
135		Very painful
140	0.03	Potential hearing loss, maximum exposure without hearing protection
151	0.10	Increased risk of hearing impairment
185	5.00	Eardrum rupture
194	15.00	Lung hemorrhage
201	35.00	Death

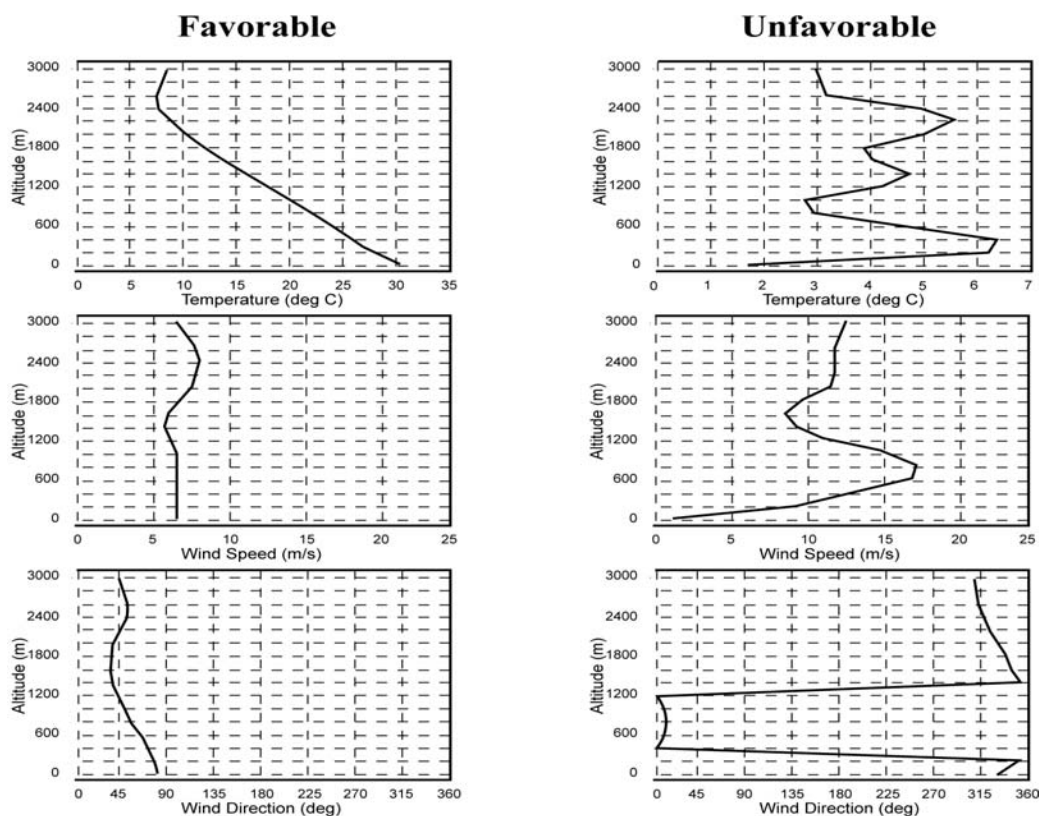
Sources: U.S. Air Force, 1996g; Golden et al., 1980

The baseline for weather condition analysis is as follows:

- **Favorable:** No temperature inversions with altitude and light, uniform, east/northeast surface winds with a moderate wind speed gradient aloft
- **Unfavorable:** Cool season day; low-altitude, layered, or multiple temperature inversions; and strong north/northwest winds

The climatic variables used to model the spatial extent of threshold noise levels are presented in Figure 4-2.

For the purpose of this analysis, the Noise Assessment and Prediction System (NAPS) model (U.S. Air Force, 1996) is used to estimate the spatial extent of mission generated noise events by creating selected noise level contours. The model also does not take into account the potentially substantial noise dampening effects of standing vegetation and terrain.



**Figure 4-2. Weather Condition Variables Used in Modeling Noise Contours**

## Noise Criteria

### *Receptor Review*

The receptor categories potentially impacted by the execution of CE-EOD open detonation activities on TA C-62 include the public and biological resources. Each category will be evaluated with respect to the potential for open detonations to adversely impact individuals and populations. The following sections provide background information concerning the public and biological receptors associated with TA C-62 that structures the environmental impact analysis.

### *Public*

The human ear is more sensitive to sounds of about 1,000 to 3,000 Hertz and less sensitive at higher and lower frequencies (U.S. Army, 2001). To approximate the response of the human ear to noise generated by TA C-62 open detonation events, the single-impulse noise event threshold is 115 dBP, unweighted peak sound pressure level. Noise estimations are based on 2,4,6-trinitrotoluene (TNT) equivalent net weight calculated with the Noise Assessment and Prediction System (NAPS) model (U.S. Air Force, 1996g). Noise studies suggest that this sound pressure level is a threshold beyond which there is a 15 percent risk of noise complaints from individuals in resident communities (Pater, 1976). The U.S. Army Center for Health Promotion

and Preventive Medicine has identified noise less than 115 dBP as having a low risk of noise complaints, 115 to 130 dBP as having a moderate risk of annoyance, and 130 to 140 dBP as having a high risk of noise complaints and potential for damage (U.S. Army, 2001).

With respect to impact potential, rapidly repeating noise events generated during Eglin's military missions have historically received the greatest number of complaints by local residents. Of the 342 noise complaints received in FY95, 87 were for single-impulse events and 256 were for subsonic aircraft noise. Of the 87 single-impulse complaints, 84 were received from individuals that lived to the south and east of Eglin (U.S. Air Force, 1996g). Since TA C-62 is in the eastern section of Eglin, some of the complaints may have been due to activities on the test area.

A query of the Eglin Detail Noise Complaint Report database (<https://129.61.138.149/noise/reports/detail.asp>) identified a noise complaint associated with CE-EOD open detonation activities on TA C-62 dated 30 March 2000 (JON No. 99962H02, Mission No. 2939). A call was received from an individual at an unspecified location complaining that a "loud explosion had knocked them out of their chairs." No physical injuries were reported.

Individuals are excluded from the safety footprint surrounding the test area during mission events, so exposure to 140 dBP and greater noise by the public is not anticipated. In addition, the Air Force has mandated that noise above 140 dBP is not to leave the Eglin reservation boundary (U.S. Air Force, 1996).

Residential areas, schools, hospitals, and businesses are likely locations in local communities where annoyance and property damage resulting from noise events could be a concern. For the purpose of analyzing the potential impacts of noise to the public, the population density data for areas off Eglin have been incorporated into this analysis (U.S. Bureau of the Census, 1992). Population density categories include <3, 3 to 39, and >39 individuals per square mile. There are several areas north of Interstate 10, such as the city of DeFuniak Springs, which has a population density greater than 39 persons per square mile.

The U.S. Army has developed Army environmental policy and official guidance for landuse planners and managers in creating, maintaining, and participating in environmental noise management programs at Army installations (U.S. Army, 2001). Instruction is provided in understanding laws and regulations, noise management planning program components, noise complaints, noise criteria and modeling, noise mitigation strategies, and community interactions.

### *Biological Receptors*

Noise disturbance can be an attractant, detractor, or deadly event for wildlife species. Laboratory studies have shown that noise can reduce reproduction in domestic animals and, as in humans, cause physical injury (Anderson et al., 1986; Mancini et al., 1988; Berglund et al., 1990). Historically, noise management has delegated annoyance-related noise activities to remote locations away from populated areas and into areas inhabited by wildlife. As a result of the Endangered Species Act, renewed importance has been placed on evaluating the impacts of anthropogenic noise events on the behavior and welfare of wildlife, especially threatened and endangered species.

The following narrative provides a screening of sensitive species potentially impacted by CE-EOD open detonation ground-based noise events, identification of the sensitive species that will be the focus of the noise impact analysis, and selection of the no-impact noise event threshold limit.

### Sensitive Wildlife Species

The seven sensitive species that occur on or may occur within one kilometer of the borders of TA C-62 that are protected by federal and/or state regulations include the:

- Gopher tortoise (*Gopherus polyphemus*)
- Eastern indigo snake (*Drymarchon corais couperi*)
- Florida pine snake (*Pituophis melanoleucus*)
- Southeastern American kestrel (*Falco sparverius paulus*)
- Florida black bear (*Ursus americanus floridanus*)
- Red-cockaded woodpecker (*Picoides borealis*)
- Florida burrowing owl (*Speotyto cunicularia floridana*)

Since each of these species are not equally at risk to noise disturbance impacts, screening is performed to identify those species individuals and populations that are most likely to be adversely impacted by the noise events generated by TA C-62 mission activities.

Reptiles such as the gopher tortoise, eastern indigo snake, and Florida pine snake do not exhibit a well-developed acoustic startle response and are often regarded as nonsusceptible to noise impacts (U.S. Fish and Wildlife Service, 1988). The gopher tortoise burrows are frequent habitats for the reptiles previously mentioned, which affords a level of protection against the effects of some noise disturbance. There is the potential to entomb some species if noise overpressures cause burrow collapse; however, no data are available that correlates a relationship between noise overpressures and this phenomenon.

The southeastern American kestrel has been sighted in the area of TA C-62. The behaviors of this raptor species of interest to this analysis are its nesting and hunting activities. The kestrels frequently locate their nests in the abandoned longleaf pine nest cavities of the red-cockaded woodpecker (RCW) (DeGraff et al., 1991). The inactive and abandoned RCW nests in proximity to TA C-62 that are tracked by Eglin's RCW monitoring program may represent potential kestrel nesting sites. The pasture-like conditions of TA C-62 and perimeter of turkey oaks and longleaf pines also provide ideal perch sites for hunting. Since no site verification data of inactive/abandoned RCW nest occupancy by kestrels were available, the species is excluded from further analysis.

The Eglin population of Florida black bears heavily utilizes stream and river systems as sources of food and cover. The floodplains, stream areas, and wetlands that characterize Burnout, Blount Mill and Oakie Creeks within relatively close proximity to TA C-62 provide potential bear



foraging and travel corridor habitat types. Floodplain swamps and bottomland hardwoods are an important and often preferred habitat type for Eglin's bear population. Since no sightings or verification data (tracks and scat) in the stream systems associated with TA C-62 were identified, the Florida black bear is excluded from further analysis.

No active RCW nest trees have been recorded within the boundaries or in close proximity to TA C-62; the closest active RCW cluster is approximately 7,200 feet to the southwest of the CE-EOD open detonation unit. Approximately 99 percent of the distance between the CE-EOD open detonation noise point-of-origin and the RCW cluster is fully stocked native pine and hardwood timber and rolling terrain, which could substantially dampen the impact potential of mission-related noise. Therefore, the RCW is excluded from further analysis.

### Florida Burrowing Owl

The sensitive species that will be the focus of this analysis is the Florida burrowing owl, a state listed species of special concern. There is a confirmed nest burrow location at the headwaters of Oakie Creek on TA C-62 – approximately 4,160 feet to the north of the CE-EOD open detonation pits. An owl was found in the burrow during a 1994 biological survey of TA C-62. Current owl habitation data were unavailable; additional surveys would be required to update use of the area by burrowing owls. Biological, anthropogenic, and landscape data that support the contention that additional owl burrows could occur on TA C-62 include the following:

- Owls normally live in colonies and use the burrows excavated by other species for breeding, nesting, and brooding. In friable soils, owls dig their own burrows if adequate ones are not available. Burrows adjacent to burrows occupied by other burrowing owls are preferred.
- The gopher tortoise burrows identified on the test area (106 burrows were identified within 823 acres of the test area during a 1994 survey) in combination with the other wildlife burrows that likely occur on TA C-62 offer potential candidate sites for owl burrows.
- Owls have an average home range of 0.96 square miles and an average diurnal activity range of 825 feet from the burrow; TA C-62 is approximately 2.02 square miles in size.
- The low vegetation and open cover that characterizes the Grassland/Shrubland of the test area is a preferred owl burrow habitat.
- Test area vegetation management mowing activities have had a beneficial effect on the owl population by increasing the subspecies' home range. In Florida, residential and industrial areas now support the largest populations of burrowing owls.

The owls' exposure to CE-EOD open detonation noise events is most likely to occur while the birds are perched in the burrow entrance or atop the mound of soil surrounding it, since this is where the owls typically spend considerable portions of the day. In Florida, nesting begins in November and continues through May.

### Avian Species Response to Noise: A Literature Review

Although lethality and physical injury are legitimate concerns, altered behaviors that adversely impact breeding success are considered an issue of greater overall impact to sensitive species, particularly avian species. Adverse changes in behaviors, such as nest abandonment or inability

to mate, could reduce reproduction success and threaten population viability. Results of a study by Delaney et al. (1999) suggest that the Mexican spotted owl (*Strix occidentalis lucida*) has an elevated nest flush response to ground-based noise.

Nest flushing and abandonment induced by ground-based noise disturbance during the nesting season have been shown to adversely impact the nesting success of some birds (Hohman, 1986). Studies of several species of raptors and other birds reported increased nest abandonment when subjected to ground-based noise disturbance (Platt, 1977; Anderson et al., 1989; Grubb and King, 1991; Delaney et al., 1999). However, there is limited data that quantifies the noise disturbance dose – behavioral response relationship or identifies noise response thresholds for wildlife species (Pater et al., 1998).

Findings by Black et al. (1984) and Gladwin et al. (1988) suggest that nesting and reproduction success may be more heavily dependent on factors associated with location, climate, and provisions of habitat than noise. In addition, research by Busnel (1978) suggests that animals react with startle behaviors to noise, but this reaction may subside over time.

Avian species have also been documented to exhibit resilience and adaptation in becoming accustomed to various types and frequencies of aerial and ground-based noise events with only slight or insignificant decreases in nesting success and productivity (Platt, 1977; Anderson et al., 1989; Ellis et al., 1991). A colony of two pairs of burrowing owls was reported to be nesting at the Imesan Airport north of Jacksonville in 1975, and in 1976 a colony was found along Interstate 10 near Falmouth in Suwannee County. An increasing portion of the Florida burrowing owl population is becoming dependent on the artificial habitats created by human activities and is becoming increasingly adapted to the noise and disturbance associated with industry and development (Kale, 1978).

#### Selected Noise Impact Threshold

Just as noise events can be injurious and lethal to humans, it is assumed that equivalent impacts may be sustained by wildlife species. However, the sound pressure level thresholds for wildlife species lethality and physical injury and threshold(s) that adversely impact sensitive species breeding and nesting success behaviors are not known. In the absence of species-specific data, the no-impact threshold metric for analyzing the potential impacts of single-impulse noise events on biological receptors is 140 dBP.

The spatial extent (noise map contours) of potential 140 dBP noise impacts is calculated using the following equation: Distance (in feet) of 140 dBP =  $600 \times \sqrt[3]{\text{NEW}}$  stated as 600 times the cube root of the 2,4,6-trinitrotoluene (TNT) equivalent amount of net explosive weight (NEW) (U.S. Air Force, 1999).

#### Sensitive Plants

No data were available concerning the impacts of noise overpressures on sensitive plants. It is estimated that the primary danger to plants is the potential rupturing of the plant cells and subsequent death of the plant that may be caused by noise overpressures of 35 psi (201 dBP) and

greater. The heat and physical disruption associated with such a sound pressure wave could also contribute to the demise of individual plants. No sensitive plants have been identified as occurring in proximity to the testing areas on TA C-62, and exposures of critical habitat areas to overpressures of 35 psi are not anticipated in the execution of current mission activities.

### *Cultural Resources*

A prehistoric site (Site Number 8WL111) has been recorded on TA C-62 at the headwaters of Oakie Creek (Figure 4-3). A recent investigation revealed that the site has been destroyed by soil erosion. The destruction of land cover by roller drum chopping and poor location and maintenance of a target access road along the stream slope crest contributed to extensive site erosion. Based on the extent of disturbance and presence of ordnance, it was determined that the site is no longer considered significant (U.S. Air Force, 2000a).



**Figure 4-3. TA C-62 Prehistoric Archaeological Site Impacted by Soil Erosion**

### *Potential Noise Impacts of CE-EOD Open Detonation Operations*

A conservative scenario for accessing the potential noise annoyance impacts to the public sector and Florida burrowing owls' physical injury and nesting and reproduction behavior impacts resulting from TA C-62 CE-EOD open detonation events was developed through interviews with CE-EOD operations personnel and is based on the following assumptions:

- On average, 5,000 lb NEW of explosive material is open detonated on TA C-62 per Ammunition Disposal Requisition (ADR) mission event. The ADR munitions are divided into two explosive packages consisting of 2,500 lb new of explosive materials per package.
- The explosive packages are open detonated 10 minutes apart using C-4 in shallow pits 100 feet apart and located on the southern portion of the test area.
- A CE-EOD open detonation is a high-order, high-yield explosion that is characterized by supersonic thermal degradation and peak overpressures.
- The primary type of explosive expended per detonation event is Tritonal.
- Based on the baseline expenditure of 30,437 lb NEW of explosive materials (Table 4-3) at a rate of 2,500 lb NEW per detonation event, there could have been 12 detonation events.
- An ADR ordnance disposal detonation is limited to no more than one MK-84 bomb (945 lb NEW) or two MK-82s (192 lb NEW per bomb) per detonation event.
- Because of the dynamics of explosive events and relative close proximity of the detonation pits, approximately 1 out of 1,000 ADR mission events will result in the near simultaneous detonation of both explosive packages.

Based on this CE-EOD Ammunition Disposal Requisition open detonation conservative scenario, the estimated radius of the noise contours during favorable weather conditions (Figure 4-2) for 115 dBP is 7.13 miles and 1.6 miles for 140dBP. The estimated spatial extent of the noise contours during favorable and unfavorable weather conditions is presented in Figures 4-4 and 4-5. In the following sections, potential impacts to the public sector and the Oakie Creek, Florida, burrowing owl colony are analyzed.

### *Public*

Based on the noise contours presented in Figure 4-4, the areas beyond the Eglin boundary are not impacted by 140 dBP noise contours. However, DeFuniak Springs residential areas, with a population density of >39 individuals per square mile and one hospital and one school, are within the 115 dBP favorable weather contour. It is estimated that the relatively infrequent mission noise events and intervening vegetation and topography would likely minimize public annoyance impacts. As illustrated in Figure 4-5, the spatial extent of 115 dBP may be substantially increased by open detonations during unfavorable weather conditions. Potentially impacted residential areas include DeFuniak Springs and surrounding rural areas and approximately 10 schools and 3 hospitals.

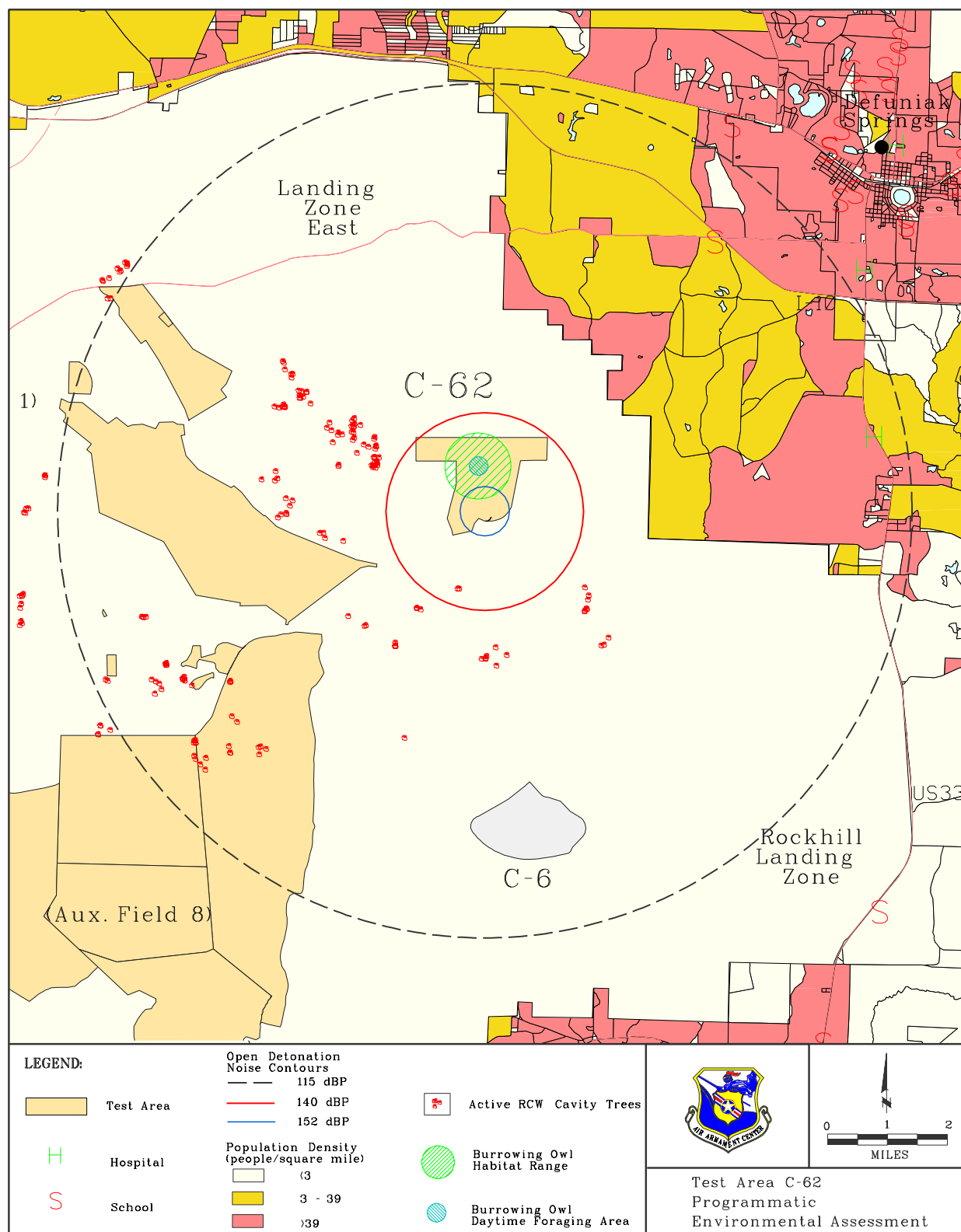
### *Oakie Creek Florida Burrowing Owl*

The Florida burrowing owl habitation areas evaluated in this analysis consisted of the known owl burrow location at the headwaters of Oakie Creek, the estimated 0.96-acre home range, and the 825-foot radius daytime foraging zones. Consideration was given to the potential owl occupation of three burrows to the east of the CE-EOD OB/OD unit along the clay assault strip (Figure 3-18). However during the 1994 survey only signs of occupation were identified with no birds being observed occupying a burrow.

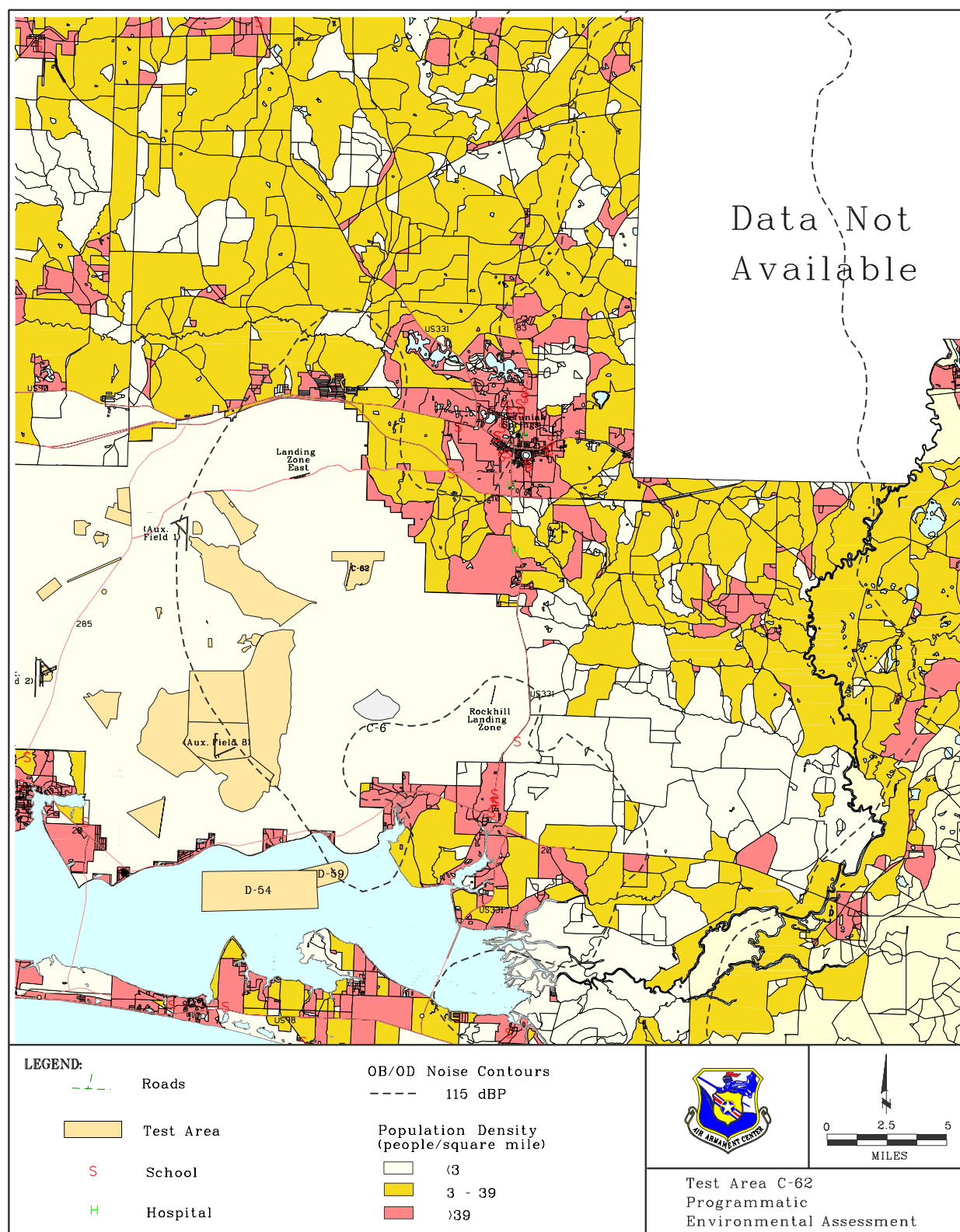
The owl at Oakie Creek is considered to be a year-round resident of TA C-62, with the potential for at least two additional pair to migrate to the test area during winter. It is within these habitation zones that the owl is likely to experience exposure to 140 dBP and greater noise levels generated by CE-EOD open detonation events on TA C-62.

Owl exposure to mission noise events would primarily occur during flight, while feeding, or while the bird is perched at the burrow entrance or on a soil mound near the burrow entrance. The owls may also use mission-related items such as target vehicles as elevated hunting perches. Flight and feeding activities that reduce the distance between the bird and the noise event point-of-origin could expose individuals to noise levels exceeding 140 dBP.

The CE-EOD open detonation conservative scenario presented in the analysis would generate two relatively equal detonation events 10 minutes apart in the pit area at the southern portion of TA C-62. Based on NAPS modeling data, the complete habitation zones of the Oakie Creek owl could be exposed to 140 dBP noise levels.



**Figure 4-4. The CE-EOD 2,500 lb NEW Open Detonation 115, 140, and 152 dBP Noise Contours During Favorable Weather Conditions**



**Figure 4-5. The CE-EOD 2,500 lb NEW Open Detonation 115 dBP Noise Contour During Unfavorable Weather Conditions**

Additional analysis identified a potential for a 65-acre section of the estimated southern home range to be exposed to 152 dBP and greater noise levels (Figure 4-4). Based on acoustic thresholds for humans (Table 4-4), exposure of owls to 152 dBP noise levels could cause slight physical injury. Data were not available to determine the degree of potential physical and behavioral impacts of 152 dBP and greater noise on the burrowing owls.

Based on the analysis, it is estimated that the owls' primary response to the open detonation noise would include startle reactions and possible nest flushing. Birds perched near the burrow could be temporally flushed from the burrow nest, but it is anticipated that the noise produced by the detonation of two 2,500-pound explosive packages during an ADR mission event would not result in nest abandonment or adversely impact breeding or nesting success. The 10-minute interval between explosive package detonations could provide an opportunity for individual birds to avoid exposure to a second 152-dBP noise event.

### Alternative 1 and 2 Noise Summary

The potential environmental consequences of noise generated by CE-EOD open detonation events are summarized in Table 4-5. Although the areas beyond Eglin's boundary are not impacted by 140-dBP noise levels, DeFuniak Springs residential areas, with a population density of >39 individuals per square mile and one hospital and one school, were within the 115-dBP noise contour during favorable weather conditions. Unfavorable weather conditions greatly extend the potential scope of noise impacts and are a primary determinant of TA C-62 mission noise impacts off the Eglin Reservation.

**Table 4-5. Alternative 2 CE-EOD 2,500 lb NEW Open Detonation Potential Noise Impacts<sup>a</sup>**

Noise Contour (dBP)	Weather Condition	Public Impact Potentials <sup>b</sup>					Florida Burrowing Owl Impact Potentials		
		Population Density			Institutions				
		<3 persons/mi <sup>2</sup>	3 to 39 persons/mi <sup>2</sup>	>39 persons/mi <sup>2</sup>	Hospital (No.)	Schools (No.)	Adults (No.) <sup>c</sup>	Home Range (acres)	Daytime Foraging Area (acres)
115	Favorable	√	√	√	1	1	1	614	49
	Unfavorable	√	√	√	~3	~10	1	614	49
140	Favorable	—	—	—	0	0	1	614	49
152	Favorable	—	—	—	0	0	0	65	0

<sup>a</sup> Noise generated by the detonation of 2,500 NEW within the open detonation unit on the southern portion of TA C-62

<sup>b</sup> Potential impact areas located outside the boundaries of Eglin AFB

<sup>c</sup> Assumes that there is one burrow and one owl at the Oakie Creek location

√ Potential exposure

There is the potential for Florida burrowing owls nesting in the Oakie Creek area to be exposed to noise levels of up to 152 dBP, which could result in slight physical injury. However, no adverse impacts to breeding and nesting success were identified. Overall, Florida burrowing owls exhibit diverse capabilities for adapting to human activities in order to take advantage of preferred habitat types as occur on TA C-62. Although there is the potential for an owl to be slightly injured from exposure to a 152 dBP noise event, overall adverse noise impacts are determined to be minimal.



An active RCW cluster to the southwest of TA C-62 is potentially impacted by 140 dBP noise generated during favorable weather; however, as previously discussed, there is approximately 7,100 feet of native timber and rolling terrain which could substantially dampen noise impacts.

#### **4.2.2 Alternative 3**

The proposed Alternative 3 noise management CE-EOD open detonation NEW limit BMP would restrict open detonations to 1,000 lb NEW per detonation event (Appendix A). Implementation of this BMP could reduce public exposure to 115 dBP noise levels during favorable weather by 27 percent compared to the 115 dBP noise contour generated by the 2,500 lb NEW detonation event scenario analyzed in Alternative 2. The school and hospital potentially exposed to 115 dBP in Alternative 2 (Figure 4-4) is excluded from the projected 115 dBP favorable noise contour of Alternative 3 (Figure 4-6).

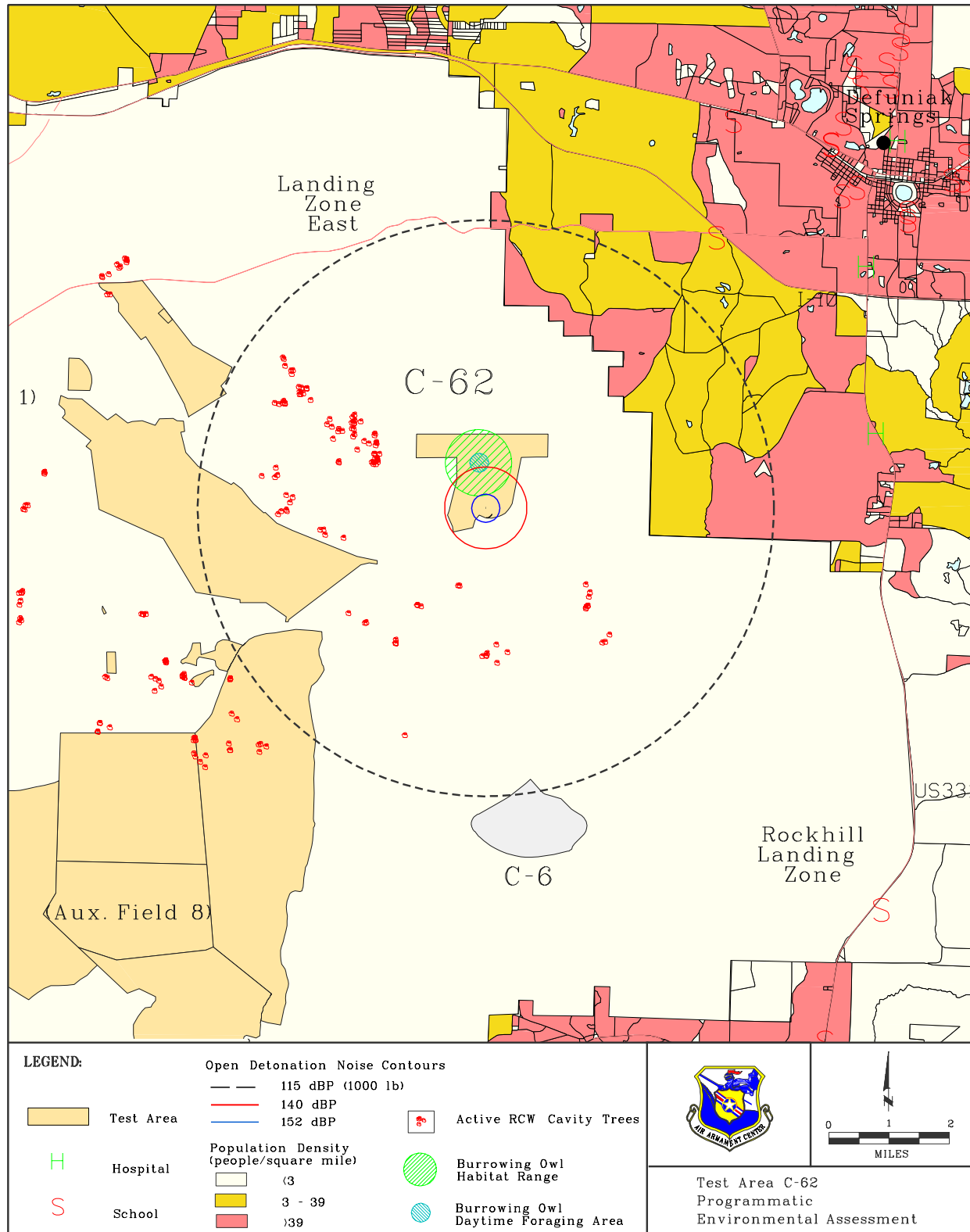
The 1,000 lb NEW CE-EOD detonation event noise abatement limitation proposed by Alternative 3 could increase the number of detonation noise events from 12 to 30. This assumes that all detonation events are performed at the conservative scenario level of 2,500 lb NEW for Alternative 2 (12 detonations) and 1,000 lb NEW for Alternative 3 (30 detonations). Actual open detonation events performed by CE-EOD could also include the detonation of explosive packages of a few hundred pounds NEW in size.

The potentials for exposure of burrowing habitat to 152 dBP as presented in Alternative 2 could also be reduced. No active RCW clusters occur within the 1,000 lb NEW favorable weather 140 dBP noise contour (Figure 4-6). Impact potentials are summarized in Table 4-6.

The reduction in the amount of explosives expended during a detonation event from 2,500 lb NEW to 1,000 lb NEW reduces the extent of the unfavorable weather noise contour; however, the change in the configuration of the 1,000 lb NEW noise contour around DeFuniak Springs increases the number of schools potentially exposed to 115 dBP noise levels from 10 to 15. This scenario denotes the extensive variability potentially associated with unfavorable noise contour quantification. The extensive interaction of noise with site-specific terrain and atmospheric variables can have acute effects on the impact potentials of mission-generated noise.

#### **4.2.3 Alternative 4**

Alternative 4 includes the CE-EOD open detonation 1,000 lb NEW as presented in Alternative 3 and does not increase CE-EOD mission expenditures; therefore, there is no change in noise impact potentials to the public or biological resources.



**Figure 4-6. The CE-EOD 1,000 lb NEW Open Detonation 115 dBP Noise Contour During Favorable Weather Conditions**

**Table 4-6. Alternative 3 CE-EOD 1,000 lb NEW Open Detonation Potential Noise Impacts<sup>a</sup>**

Noise Contour (dBP)	Weather Condition	Public Impact Potentials <sup>a</sup>					Florida Burrowing Owl Impact Potentials		
		Population Density			Institutions				
		<3 persons/ mi2	3 to 39 persons/ mi2	>39 persons/ mi2	Hospital (No.)	Schools (No.)	Adults (No.) <sup>b</sup>	Home Range (acres)	Daytime Forging Area (acres)
115	Favorable	√	√	√	0	0	1	614	49
	Unfavorable	√	√	√	~3	~15	1	614	49
140	Favorable	—	—	—	0	0	1	197	9
152	Favorable	—	—	—	0	0	1	2	0

<sup>a</sup> Potential impact areas located outside the boundaries of Eglin AFB<sup>b</sup> Assumes that there is one burrow and one owl at the Oakie Creek location

√ Potential exposure

#### 4.2.4 Noise Summary

The 115 dBP noise levels generated by CE-EOD open detonations during favorable and unfavorable weather as presented in all the alternatives may leave the boundaries and potentially effect the public sector in the vicinity of DeFuniak Springs to the northeast of TA C-62. The 1,500 pound reduction in the net explosive weight of open detonation events from 2,500 lb NEW to 1,000 lb NEW as proposed by Alternative 3 and 4 could substantially reduce public sector and biological exposure potentials. Based on the CE-EOD open detonation baseline expenditure of 30,437 lb NEW, the frequency of detonations could increase from 12 events for Alternative 2 to 30 events for Alternatives 3 and 4. This conservative analysis assumes that all detonations would be 2,500 lb NEW or 1,000 lb NEW in size. A noise issue summary for Alternatives 1 through 4 is presented in Table 4-7.

**Table 4-7. Alternatives 1 through 4 Noise Summary**

Environmental Analysis		Alternatives		
Issue	Criteria	1 and 2	3	4
Noise				
Public Exposure (outside Eglin)	>115 dBP			
Favorable Weather				
Population Density (individuals/square mile)				
<3		√	√	√
3 to 39		√	√	√
>39		√	√	√
Schools (Number)		1	0	0
Hospitals (Number)		1	0	0
Unfavorable Weather				
Population Density (individuals/ square mile)				
<3		√	√	√
3 to 39		√	√	√
>39		√	√	√
Schools		~10	~15	~15
Hospitals		~3		
Burrowing Owl Habitat				
Home Range (acres)	Favorable Weather Noise Levels			
>140dBP		614		
>152 dBP		65		
Daytime Forging Area (acres)				
>140dBP		49		
>152 dBP		0	0	0

√ Potential exposure

### 4.3 HABITAT ALTERATION

This section analyzes the potential for TA C-62 mission activities to adversely impact the physical condition of habitats associated with TA C-62. The primary habitats associated with the test area that will be the focus of this analysis include adjacent Sandhills and the test area Grassland/Shrubland ecological associations, the test area Oakie Creek wetlands, and the gopher tortoise and Florida burrowing owl burrows. Ecological sensitivities of concern include gopher tortoise and Florida burrowing owl burrow collapse, soil erosion, wildfires, and cultural resource disturbance.

#### 4.3.1 Alternative 1 (No Action) and 2 (Authorize Current Level of Activity)

The TA C-62 baseline mission activities of potential consequence to this analysis include:

- Air-to-Surface Bomb Testing and Delivery Training
- High Performance Aircraft Gunnery Training
- Shoulder-Launched M190 Missile and LAWS Rocket Training Ground Operations
- Civil Engineering Explosive Ordnance Disposal (CE-EOD) Operations
- UXO Detection Testing
- Aircraft Gunnery Target TT-3 Maintenance
- Test Area Vegetation Maintenance Roller Drum Chopping
- Test Area Roads

Refer to Table 4-3 for a summary of the CE-EOD open detonation baseline expenditures. A summary of the baseline air-to-surface bomb, gunnery, and rocket and missile training and testing operation expenditures is presented in Table 4-8; target locations and features are shown in Figure 4-1. A summary of bomb features is presented in Appendix D.

The air-to-surface delivery of 1,510 BDU-33 and 337 BDU-50 inert bombs on target TT-1 (Figure 4-1) is the mission baseline for this analysis. Additional information on the characteristics of the BDU-33 and BDU-50 is presented in Appendix D. The mission activity on TA C-62 during which live air-to-surface bombs were used was the testing of 10 CBU-97 smart bombs on target TT-5. During the baseline year FY96, 10 CBU-97s were expended. There are no fixed coordinates for target TT-5. Target TT-5 is an unscorable tactical target consisting of four vehicles that are moved as required to accommodate cleared and camouflaged testing and training needs.

For the baseline period, 13,731 rounds of 20 mm TP M99 practice ammunition was expended on target TT-3 during low angle aircraft strafing gunnery training, which accounted for 88 percent of all air-to-surface training and testing expenditures during the baseline period. Typically, aircraft fire between 200 and 300 rounds of ammunition at a rate of 30 to 50 rounds per strafing run. Additional information on the characteristics of 20 mm TP M99 ammunition is presented in Appendix D.

Table 4-8. Alternative 2 Air-to-Surface and Ground Operations Baseline Expenditure Summary

Mission		Expenditures			
Operation	Category	Munition Type	Target/ Area(s) <sup>a</sup>	Fiscal Year (FY)	Number of Expenditures
Air-to-Surface Bomb and Gunnery Operations	Live Bomb Testing	CBU-97 Smart Bomb	TT-5	FY96	10
		M18 Smoke Grenades	TT-5	FY95	272
		0.5 lbs. HE C-4 <sup>b</sup>	CE-EOD OD Area	FY96	34
	Inert Bomb Training	BDU-33	TT-1	FY97	1,510
		GBU-10	TT-4	FY95	19
		BDU-50	TT-1	FY96	337
		MK-20	TT-1	FY97	1
		MK-82 LD	TT-1	FY97	6
		MK-84 LD	TT-1	FY96	34
		BLU-109	TT-1	FY96	2
	Gunnery Training	20 mm TP	TT-3	FY96	13,731
	<b>Subtotal</b>				<b>15,956</b>
LAWS Rocket and M190 Missile Ground Operations	Live Missile Testing	40 mm HE	Expended at unknown locations on the test area	FY95	32
		35 mm M190	TT-7	FY95	2,002
	Practice Missile and Rocket Training	66 mm LAWS	TT-7	FY95	5
	<b>Subtotal</b>				<b>2,039</b>
	<b>Total</b>				<b>17,995</b>

<sup>a</sup> Target areas are shown in Figure 4-1.

<sup>b</sup> CE-EOD used the C-4 to dispose of unexploded CBU-97 submunitions (skeets).

Source: U.S. Air Force, 1998a; U.S. Air Force, 1998b

The Hurlburt Small Arms Range Complex expenditure of 2,002 shoulder-launched 35 mm M190 practice missiles during training operations accounted for 98 percent of the testing and training ground operations performed at TA C-62 during the baseline period. The M190 practice missiles were fired at the simulated tin tanks at target TT-7 located on the north stream slope of Oakie Creek.

For UXO detection testing purposes a total of 503 inert targets (mortars, artillery shells, submunitions, warheads, bombs and mines) were placed on the surface or buried at precise locations, depths, and orientation within UXO detection test area. Using established coordinates, each item is easily recovered, which results in no known habitat impacts.

## Environmental Analysis

In this section, the TA C-62 habitat alteration ecological sensitivities are described and the primary interactions between the selected mission activity effectors and test area ecological sensitivities are identified. Each selected mission activity will be individually analyzed and potential consequences to the environment of TA C-62 will be identified. Habitat alteration on TA C-62 is primarily associated with the physical impact of inert ordnance projectiles or debris with the land and CE-EOD OD operations, which could result in surface disturbance or wildfires. The following discussion reviews habitat alteration ecological sensitivities followed by an environmental impact screening to focus the analysis on issues of greatest concern.

### *Habitat Alteration Ecological Sensitivities*

The TA C-62 habitat alteration ecological sensitivities described in this section include gopher tortoise burrows, soil erosion, and wildfires. Potential impacts to burrowing owl burrows are not included in this analysis because of the distance from target areas (approximately 1,000 feet) and the lack of data to support the utility of the owl burrows by other potentially sensitive species. Owls frequently evict species occupying a preferred burrow nest and are not prone to allow occupancy of the burrow by other animals.

#### *Gopher Tortoise Burrow Habitats*

Air-to-surface bombing and gunnery activities, ground operations missile and rocket expenditures, and CE-EOD open detonation activities on TA C-62 could degrade the structural integrity of gopher tortoise habitats by causing partial or complete collapse of the burrow entrance and interior. Burrow habitat damages are likely caused by direct physical disturbance of the burrow walls by bombs, gun ammunition, missiles or vibrations caused by the open detonations of explosive materials by CE-EOD during ordnance disposal operations. It is anticipated that the extent of exposure to physical burrow damage is greatest for air-to-surface bombing activities.

Gopher tortoise burrow damage is a potential threat to the tortoise as well as the diversity of commensal species that frequently use the burrow habitat (Appendix C). Generally, gopher tortoises are able to dig out following burrow entrance collapse events in sandy soils (Landers and Buckner, 1981; Diemer and Moler, 1982; Diemer, 1992). It is unlikely tortoises would be entombed by entrance or partial interior borrow collapse; exceptions may occur if soil or debris is mounded over the entrance and the tortoise is located in the chamber at the end of the burrow during a collapse of a major portion of the burrow. Effects on commensal burrow inhabitants are not known.

Analysis of impacts to gopher tortoise burrows within open grassland areas is performed using an average gopher tortoise density. The exact location of burrows over the extent of the test area has not been determined; therefore approximations are used to estimate burrow density. Based on a 1994 biological survey of TA C-62, it is assumed that there are approximately eight active tortoise burrows per 100 acres on the test area or 0.08 burrows per acre.

*Soil Erosion*

Military mission induced soil erosion is a direct contributor to the alteration of TA C-62 terrestrial and aquatic habitats. Primary sources of erosion on TA C-62 include test area roller drum chopping, air-to-surface bombing and aircraft gunnery training, test area target and road maintenance, and CE-EOD operations. Surface erosion becomes particularly problematic when disturbance activities are in proximity to waterways. Eroded soil that leaves the site of origin and enters streams becomes sediment, which is considered by regulatory agencies as nonpoint source of pollution (NPS). Sedimentation is identified as a major source of NPS impairment in U.S. waterways. Excessive sedimentation results in destruction of fish habitats, decreased recreational uses, and loss of water storage capacity. From a water quality standpoint, the relationship between gross erosion (loss of soil from a section of land) and sediment yield (loss of suspended solids from the watershed) is complex; changes in erosion do not necessarily translate simply into changes in sediment yield. A discussion of the soil erosion process is presented in Appendix G.

Sediment delivery is active in the headwaters of Oakie Creek, Blount Mill Creek, and Burnout Creek, which may constitute a violation of the Clean Water Act.

In addition to the costs associated with environmental damage, the off-site and on-site costs of soil erosion from TA C-62 could include:

- Additional downstream water treatment needs
- Payments for soil erosion related damage to downstream landowners and land users
- Increased flood damage
- Reduced recreational value and use of streams, rivers, and bays resulting from impaired water quality and siltation of waterways

Potential impacts of soil erosion on the performance of military missions on TA C-62 include:

- Increased engineering requirements – replacement of lost topsoil; restoration of soil productivity; regrading, repair, replacement, and maintenance of target areas; and road repair and regrading
- Heavily eroded areas becoming impassable to vehicles
- Realism of the natural environment being diminished
- Degradation of test area viability to support missions in a sustained manner

Soil erosion on TA C-62 may adversely impact environmental stewardship missions including the protection of significant habitat and species as occur in the Blount Mill Creek seepage slope bog and cultural resources. The ecosystem degradation resulting from soil erosion on TA C-62 adversely impacts the military mission performance capabilities of the test area. Sustaining the quality of the test area ecosystem increases the integrity and prolongs the value of the test area for mission support. TA C-62 Erosion Impact Areas (EIAs) identified as sites of active soil loss by water erosion include:



- Blount Mill Creek Headwater (EIA-1)
- Oakie Creek Ridge Road (EIA-2)
- Oakie Creek North Boundary RR 380 (EIA-3)
- Burnout Creek Headwater (EIA-4)

Each EIA is discussed in detail in Section 3.4.5. EIA erosion sources include roller drum chopping test area maintenance, target maintenance, road construction and maintenance, and CE-EOD operations. The EIAs identified on TA C-62 are shown in Figure 3-34.

### *Wildfire*

The high heat of thermal combustion generated by the expenditure of propellants and/or high explosives and direct impact of vegetation fuel sources with superheated projectiles and metal fragments presents a threat of wildfires on TA C-62, particularly during dry periods. A recent CE-EOD open detonation ignited a wildfire south of the detonation pit that burned approximately two acres (Figure 4-7). The locations of documented wildfires WF 5023 and WF 5058, which were in close proximity to TA C-62, are presented in Figure 4-8.



**Figure 4-7. Wildfire Ignited by CE-EOD OD/OB Operations**

The longleaf pine community south of TA C-62 to the west of WF-5058 along Blount Mill Creek has obviously benefited from mission related fire events. As seen in Figure 3-4, fire events have created a scattered longleaf pine overstory, sparse hardwood midstory, and dense ground cover dominated by grasses and forbs that is reminiscent of fire maintained stage of succession that characterized presettlement Sandhill communities.

The primary concern with fires is natural fuel build-up, frequency of fires, and the tolerances of vegetation to fire events. As shown in Figure 4-14, the typical fuel build-up on some parts of TA C-62 is relatively low, which limits the potential for devastating fires on the grassland/shrubland ecosystem of the test area. Fires can cause extensive damage to timber stands if they occur as wildfires under conditions of high-fuel and dry climate in a sequence that is contradictory to natural fire events.

Because gopher tortoises and Florida burrowing owls frequently occupy fire-dependent communities, fire tends to have a beneficial effect on the habitat used by these species. Periodic fire keeps the sandy soils open for burrowing and maintains the early successional stages that tortoises, burrowing owls, and most of their reptile and mammal prey require (Landers, 1987). Preferred gopher foods such as the partridge pea increase in response to fires. Although no documentation of fire-related mortality to gopher tortoises or burrowing owls by wildfires was identified, it is possible that an owl trapped in its burrow during a fire could be asphyxiated.

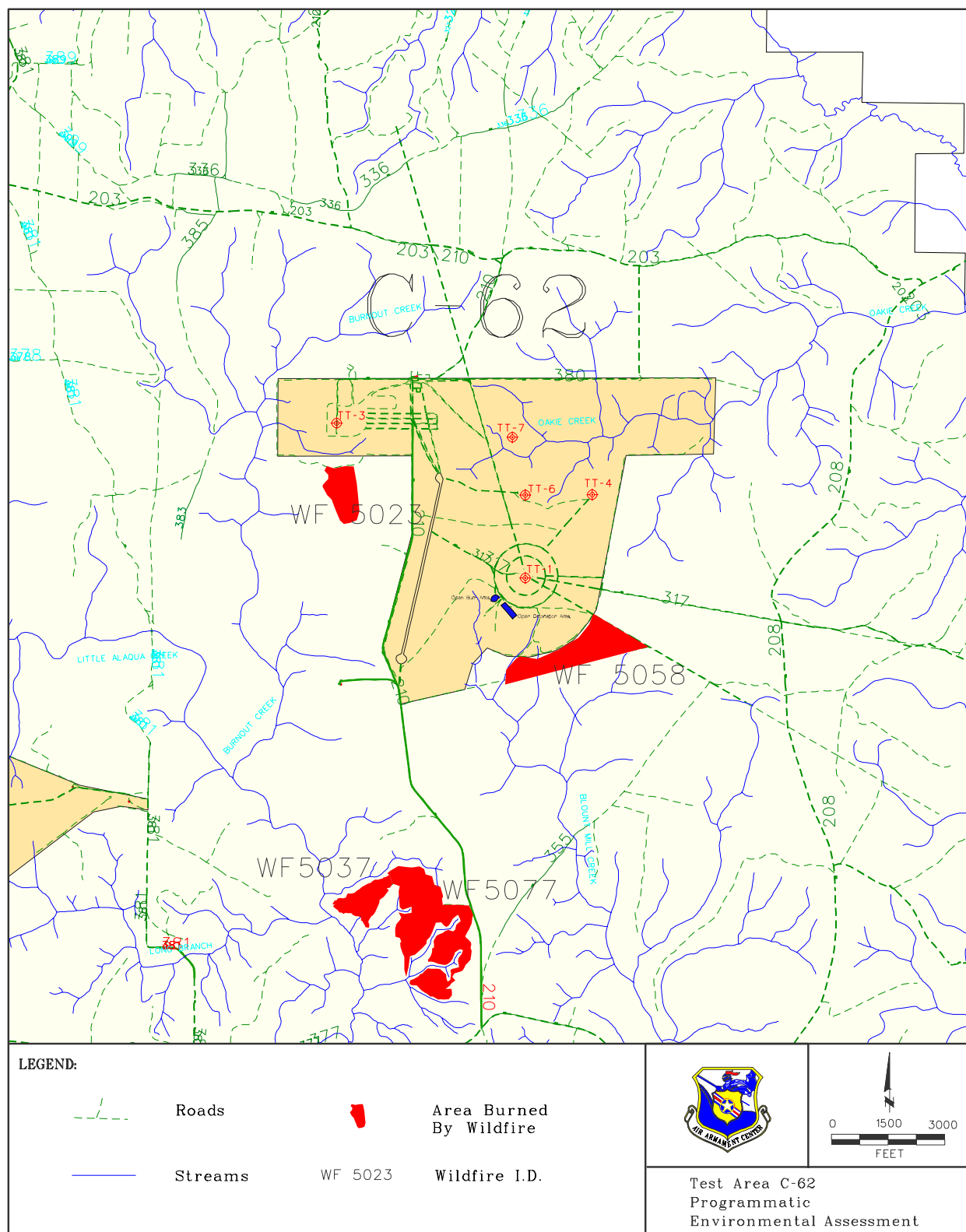


Figure 4-8. TA C-62 Documented Wildfires

***Habitat Alteration Environmental Impact Screening***

The potential interactions between current mission activities and ecological sensitivities of concern that are the focus of this analysis are identified in Table 4-9. The potential impact interactions of mission activities and ecological sensitivities are evaluated in the following sections. Metric measures and/or threshold criteria are used to quantify potential impacts.

**Table 4-9. Potential Habitat Alteration Effector and Receptor Interactions**

Mission Activity	Ecological Sensitivities		
	Gopher Tortoise Burrow Collapse	Soil Erosion	Wildfires
Air-to-Surface Bomb Delivery Training	●	√	—
20 mm Aircraft Gunnery Training	√	√	—
35 mm M190 Missile Training Ground Operations	√	√	√
CE-EOD OB/OD Operations	●	●	●
UXO Detection Testing	—	—	—
Aircraft Gunnery Target TT-3 Maintenance	—	●	—
Test Area Vegetation Maintenance Roller Drum Chopping	●	●	√
Test Area Roads	—	●	√

● = Potential impact

√ = Minimal impact

— = No impact

UXO detection testing is considered an environmentally benign activity with regard to habitat alteration issues. The inert test items (Table 3-9) are precisely placed, which minimizes the potential for impacting sensitive species or habitats. The topography of the UXO detection-testing site is relatively flat with overall slope gradients of one percent or less. The 25-acre testing area is not roller drum chopped, which has allowed vegetation to fully cover the area. Soil excavations for burying target items are relatively small in size and the disturbed site is immediately repaired. Evidence of concentrated runoff and related erosion was not observed. Under AF813-RCS#98-031, the proposed BoomSAR UXO detection testing action qualified for Categorical Exclusion; therefore, the mission activity is excluded from further environmental analysis.

The TA C-62 mission activities of potential consequence to habitat alteration are air-to-surface bomb delivery training and CE-EOD open detonation operations. The rationale for excluding 20 mm aircraft gunnery and 35 mm M190 missile training from further impact analysis is as follows:

- *Gopher Tortoise Burrow Collapse*: It is estimated that the 156 gram (0.34 pound) M190 missile and 129.6 gram (0.28 pound) 20 mm practice round projectile would create a minimal amount of surface disturbance at the burrow entrance and would not impact the subsurface portions of the burrow. The relatively low-angle trajectory of these expenditures at the point-of-impact with the surface would minimize soil penetration potentials and reduce burrow entrance collapse potentials.

- *Soil Erosion:* The surface disturbance created by the impacts of 20 mm gun projectiles and 35 mm M190s is of limited consequence to land cover by native species. No evidence of active soil erosion caused by projectile or missile impacts was identified. However, 20 mm aircraft gunnery training TT-3 target maintenance practices are a primary contributor to soil erosion and sedimentation of a Burnout Creek headwater stream.
- *Wildfires:* Although the metal components of the 20 mm projectile may be hot, there is no evidence to substantiate a ground impact heat source that could ignite a vegetative fuel source even under dry conditions. In a firing scenario from the eastern boundary TA C-62 spotting tower to target TT-7, it is anticipated that the M190 missile propellant would be fully expended at impact with the target. Investigation of wildfire data did not identify a fire on the test area that was ignited by 20 mm projectiles or M190 missiles.

Although not a direct mission testing or training activity, certain test area maintenance activities have a direct impact on the environment. These TA C-62 activities include roller drum chopping vegetation management, aircraft gunnery training TT-3 target maintenance, and test area road maintenance. The potential for air-to-surface bomb delivery training, CE-EOD open detonations operations, and test area target and road maintenance activities to adversely impact the habitats associated with TA C-62 are analyzed in the sections that follow.

### ***Air-to-Surface Bomb Delivery Training***

The baseline effectors used in this analysis are the 1,510 BDU-33s and 337 BDU-50s dropped on target TT-1. The inert, unguided BDU-33 weighs about 25 pounds and is capped with a spotting charge (0.083 lb NEW) that normally detonates on impact with the surface; the spotting charge assists observers in target scoring. Upon impact with the surface, the bombs will remain relatively intact, remain on the surface near the point of impact, become partially embedded in the soil, and/or skip on the surface.

Based on field observation and conversations with mission personnel, the BDU-33s dropped on TA C-62 are prone to remain within 50 feet of impact with skipping distances of greater than 50 feet being an infrequent event. Maximum BDU-33 bomb penetration of the soil is estimated to be less than one foot. It is estimated that the delivery of BDU-33s on target TT-1 would primarily impact the collapse of the gopher tortoise burrow entrance.

The 514 gross pounds BDU-50s dropped on TT-1 are of greater potential consequence to overall burrow collapse because of their capability to penetrate the soil deeper than the BDU-33. It is estimated that the maximum depth a BDU-50 would penetrate the soil on TT-1 is 20 feet. This assumes an almost vertical entry and minimal deflection as the bomb passes through the soil. Based on the angle of descent, the bomb is also more prone to skip than the BDU-33.

To evaluate the potential tortoise burrow damage probabilities for BDU-33 and BDU-50 bombing at target TT-1 requires the design of bomb impact and ricochet containment footprints. The weapon safety footprint methodology presented in U.S. Air Force Regulation 50-46 (U.S. Air Force, 1987) was used to estimate bomb footprints on target TT-1. The BDU-33 and BDU-50 footprints presented in Figure 4-9 specify a 99.99 percent level of containment at the 95 percent confidence level.

The Primary Bomb Containment Area (PBCA) is identified as a 1,000-foot radius zone that captured 90 percent of the baseline expenditure of BDU-33s and BDU-50s dropped on target TT-1 (Figure 4-9). The estimated PBCA containment is based on the diversity of bomb delivery missions that can be performed on TA C-62 and the potential for the BDU-50s to ricochet on the surface following impact. For this analysis, it is assumed that the BDU-50s were delivered during high angle dive bomb missions that minimize ricocheting and promote bomb subsurface penetration.

The 1,000-foot radius of the PBCA also provides a better representation of the potential risks of tortoise burrow impacts by air-to-surface deliveries. The area within 500 feet of the target center is subject to frequent disking and is essentially devoid of vegetation, whereas the area beyond the 500-foot radius is vegetated, relatively undisturbed, and more prone to support tortoise occupancy.

Target TT-1 mission and footprint calculation parameters and TA C-62 authorized bomb delivery techniques used in the design of the gopher tortoise burrow impact scenario are presented in Table 4-10.

**Table 4-10. Target TT-1 Air-to-Surface Bombing Mission and Footprint Parameters**

Mission Parameters		Footprint Parameters (feet)	
BDU-33			
Aircraft	F-15	Long (down range)	2,300
Event	Low Angle Bomb (-15 to -20 degrees)	Short (back range)	2,800
Target	Soft	Cross Range	1,800
Altitude Release	1,700 to 2,500 feet		
BDU-50*			
Aircraft	F-15	Long (down range)	5,475
Event	High Angle Dive Bomb (-20 to -60 degrees)	Short (back range)	5,475
Target	Soft	Cross Range	5,475
Altitude Release	1,700 to 12,000 feet		
TA C-62 Authorized Deliveries			
Dive Bomb, High Altitude Dive Bomb, Dive Toss, Low Angle Low Drag, Low Angle Bomb, Rockets, High Angle Strafe, Visual/Radar Laydown, Visual/Radar Low Altitude Drogue Delivery, Air Surveillance Radar Team Beacon Bomb, Loft, and Stabilized Climb			

\* Footprint derived from General Purpose bomb scenario  
Source: U.S. Air Force 1987

Analysis of the potential probability for a BDU-33 and a BDU-50 dropped on TT-1 to impact a gopher tortoise burrow is based on the following assumptions:

- For the baseline period, 90 percent of the BDU-33s (1,359 bombs) and BDU-50s (303 bombs) impacted the TT-1 PBCA. The remaining 151 BDU 33s and 34 BDU-50s are evenly distributed within the remaining portions of the footprint areas.
- All BDU-33 deliveries were dropped by F-15s during low angle bomb deliveries (-20 degrees) along the TT-1 north run-in flight line. All BDU-50s were dropped by F-15s during high-angle dive bomb deliveries (-60 degrees) along the TT-1 317 east run-in flight line (Figure 4-9).

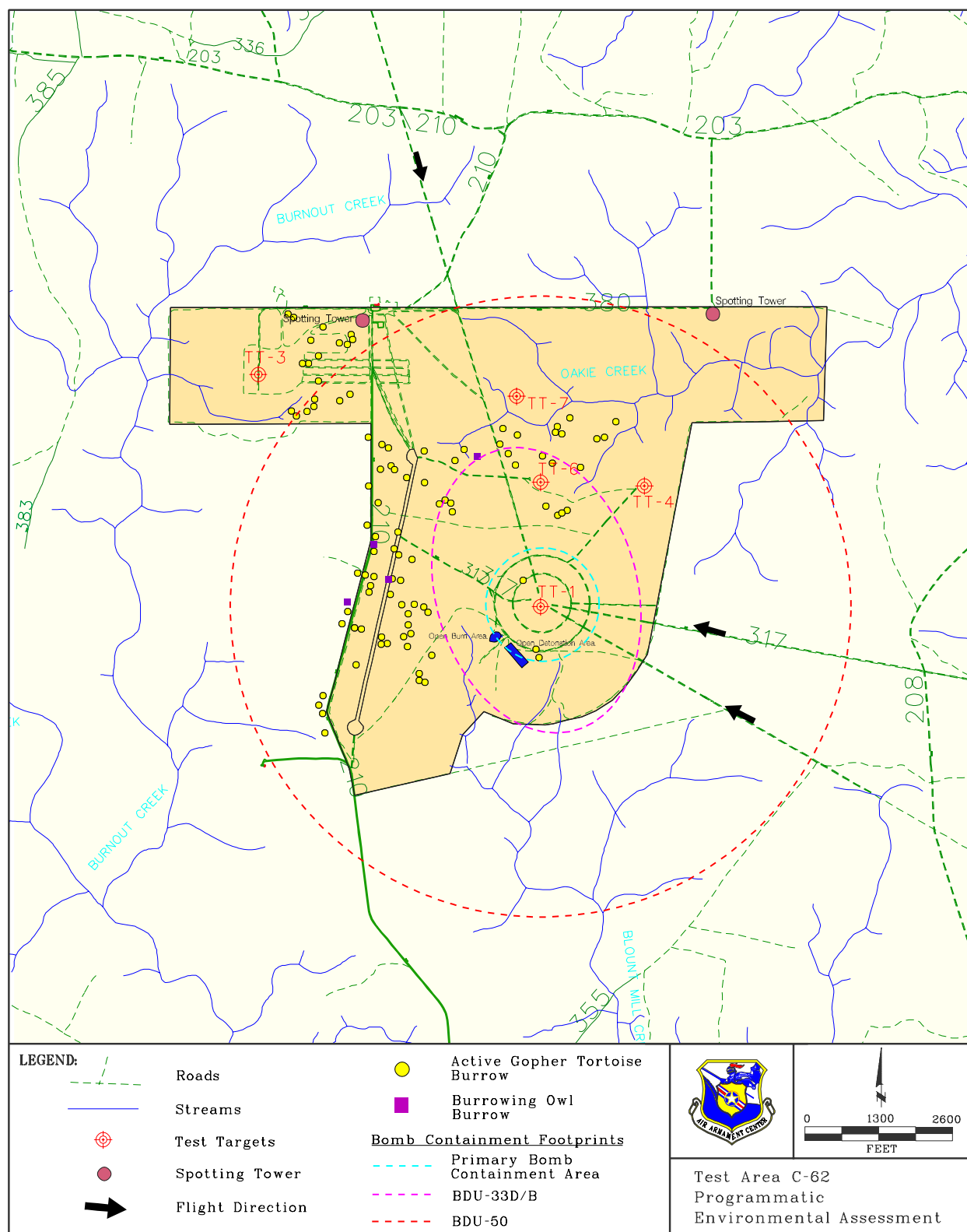


Figure 4-9. Target TT-1 Air-to-Surface Bomb Impact Footprints



- Based on a test area density of eight gopher tortoise burrows per 100 acres on TA C-62, there are 5.8 tortoise burrows within the approximately 3,141,600 square foot TT-1 PBCA. The remaining BDU-33 footprint contains about 11,185,000 square feet and the BDU-50 portion within the test area boundary contains about 44,386,000 square feet.
- A burrow within the bomb footprints on TT-1 occupies 20 square feet (20 feet long and one foot wide) and the burrow entrance impact area occupies one square foot. Within the footprints, a burrow entrance does not overlay subsurface portions of a tortoise burrow. The average depth to intersect the burrow wall is six feet.
- Detrimental damage to the burrow entrance requires a direct hit by a BDU-33 on the burrow entrance area. A BDU-50 will cause detrimental damage to the burrow entrance if an impact occurs within two feet of the entrance edge. Detrimental damage to the subsurface portions of the burrow necessitates the direct impact of a BDU-50 with the burrow interior walls. The size and configuration of a burrow entrance is illustrated in Figure 4-10.



Figure 4-10. TA C-62 Active Gopher Tortoise Burrow

- Forty percent of the TT-1 PBCA target subsurface – to a depth of 10 feet – is occupied by historical expenditures of inert bombs that act to deflect bomb travel through the soil profile and promote horizontal movement and lodging.
- Seventy five percent of the BDU-50s (227 bombs) penetrate the PBCA surface area and 25 percent (76 bombs) skip on the surface or are partially buried in the soil. Of the 227 bombs that penetrate the surface, 50 percent (113 bombs) travel to a depth of 10 feet. BDU-50s that ricochet outside the PBCA containment zone remain on the surface.
- All the BDU-33s remain on the surface within 50 feet of impact or are buried to a depth of one foot or less.
- It is estimated that it would take greater than two direct hits to the tortoise burrow entrance by a BDU-33 to entomb species. However, an impact to the burrow entrance by a BDU-50 could cause a level of soil disturbance and mounding that could entomb burrow species including the tortoise.
- Burrow impact analysis is based on a receptor take probability scale of 0 to 100 percent. For the purpose of this analysis, the threshold value for a receptor take is 20 percent with the probability increasing as the value increases.

The estimated gopher tortoise burrow impact probabilities are presented in Table 4-11. The calculations used to estimate impact probabilities are presented in Appendix C.



**Table 4-11. Air-to-Surface Inert Bomb Gopher Tortoise Burrow Impact Probability**

<b>Tortoise Burrow Impact Scenario</b>	<b>Probability (%)</b>
Entrance collapse by 1,359 BDU-33s striking the TT-1 PBCA	0.03
Entrance collapse by 303 BDU-50s striking the TT-1 PBCA	0.03
Subsurface collapse by 113 BDU-50s penetrating the TT-1 PBCAt	0.50

PBCA = Primary Bomb Containment Area

Since all probability values are substantially less than the 20 percent threshold and relatively close to a no hit probability, there is a negligible probability for a BDU-33 and BDU-50 to damage a burrow entrance or a BDU-50 to impact subsurface burrow walls and cause a collapse of the burrow interior within the target TT-1 PBCA. On the extremely rare occasion that a BDU-50 impacts the interior walls of the burrow chamber, there is the potential for tortoises and commensal species located in the chamber to be entombed; tortoises in other portions of the burrow could probably dig out.

### ***CE-EOD Open Detonation Operations***

Ammunition Disposal Requisition mission event packages of up to 3,000 pounds of explosive material are detonated by CE-EOD in two excavated pits approximately 300 feet apart within the 200 × 400-foot open detonation area located on the southern portion of TA C-62 (Figure 4-9). The pits are excavated to dimensions that suit the type and quantity of explosive materials expended with most pits being a few feet deep. The amount of soil evacuated by the explosion depends on the types and amount of explosive materials detonated. As shown in Figure 4-11, large explosive packages can remove substantial amounts of soil. The pit in Figure 4-11 is located on the western end of the open detonation area and measures approximately 30 feet across and 20 feet deep.

The approximately two feet of water in the bottom of the pit is likely an exposed portion of a perched water table. This is based on the fact that the Blount Mill Creek seepage slope bog is approximately 550 feet down slope to the west. Most seepage slopes occur as a result of an underlying relatively impermeable clay layer. At the time of the photograph, it had been at least two and one-half weeks since the last substantial rainfall. In the absence of a perched water table, the naturally high permeability rates of this Lakeland soil and soil fracturing caused by detonations would have minimized ponding and allowed runoff to infiltrate through the soil in a relatively short period. The soil saturation zones (dark shading) above the water line signify the inflow of groundwater rather than the collection of rainwater. The contribution of runoff from the surrounding watersheds is also considered to be minimal. The same detonation pit over a year later following an extended period of rain had a depth to water surface of approximately 5 feet and depth to bottom of approximately 8 feet (Figure 4-12). Based on the erosion rill scars along the mouth of the crater, it is estimated that soil was washed into the pit reducing the overall bottom depth by approximately 10 feet.



**Figure 4-11. CE-EOD Open Detonation Crater (January 2000)**



**Figure 4-12. CE-EOD Open Detonation Crater (August 2001)**

The result of the open detonation of a 2,500 pound explosive package by CE-EOD of potential consequence to habitat alteration is the rupturing and destabilization of the soil profile, surface denudation, and blast sedimentation. Of particular concern to this analysis is the proximity of the open detonation area to the headwater stream segment of Blount Mill Creek (Figure 3-26). The detonation pit area is situated between two first-order, perennial, seepage-fed eastern and western stream segments that contribute water flow directly to Blount Mill Creek. The stream slopes associated with these stream segments are approximately 400 feet from the open detonation area. There is also a high quality seepage slope bog wetland along the western headwater stream of Blount Mill Creek.

#### *Gopher Tortoise Burrow Collapse Analysis*

A literature review and communications with experts in the field identified an absence of information concerning the potential effects of CE-EOD open detonation explosive blast vibrations on gopher tortoise burrow integrity. However, the 1994 biological survey data located an active tortoise burrow adjacent to the open detonation area. Since burrows on average are about six feet deep, but may reach depths of 18 feet, the deeper burrow may be less prone to complete collapse in response to surface blast events because of the buffering effect of the overburden. A tortoise located in the burrow chamber and other commensal species located in other portions of the burrow following a vibration type collapse could be entombed. Only 14 burrows of 291 were observed as being collapsed during the gopher tortoise survey of 1994. During the 1994 gopher tortoise burrow survey two active burrows were identified within 300 feet of the CE-EOD open detonation area (Figure 3-26) which presents evidence that ground-transmitted shock was not sufficient to completely destroy the burrow and/or impede reconstruction of a damaged burrow.

#### *Soil Erosion*

The repeated surface disturbance caused by historical CE-EOD open detonations before the implementation of environmental permitting on or in close proximity to the stream slopes of the western headwater of Blount Mill Creek was a primary contributor to the extensive soil loss, slope damage, seepage slope bog degradation, and stream sedimentation that has occurred on

Erosion Impact Area (EIA)-1. Blount Mill Creek Headwater EIA-1 is described in detail in Section 3.4.5.

There is physical evidence that at one time detonation pits were located at the crest of the stream slopes (Figures 3-37a and 3-37b). The soil profile fracturing, denudation of slope vegetation, and sedimentation of the slopes caused by detonation blasts at these sites likely contributed to the initiation of a soil erosion process that has resulted in overall slope failure of EIA-1 and migration of sediment towards and into the western headwater stream segment of Blount Mill Creek. It is estimated that approximately 5,000 tons of soil have been lost from the site and the areas continues to erode at 116 tons/acre/year. Calculations for estimating erosion rates are presented in Appendix C.

Soil erosion associated with EIA-1 is identified as a direct threat to the high quality seepage slope bog on the western stream segment of Blount Mill Creek and the FNAI Tier I Pine Sandhill habitat to the south of the test area (Figure 3-11). Two state listed threatened plants (the red flowered pitcher plant (*Sarracenia rubra*) and the water sundew (*Drosera intermedia*)) were identified to occur within the seepage slope bog. Several sediment deposition fans were observed to be encroaching onto this sensitive wetland habitat. Inundation of dominant herbaceous ground cover by sediment could change the site hydrology and bury sensitive plants that have been identified on the site. Minor changes in slope elevations could alter hydrology sufficiently to promote invasion by woody shrubs as was observed at Oakie Creek. Once established and excluding fire events, woody shrubs tend to dominate altered sites, which diminishes the integrity, unique vegetative diversity, and habitat value of the wetland.

#### *Wildfire Analysis*

Wildfire WF 5058 was caused by the detonation of explosive materials at the TA C-62 open detonation area. The Eglin Natural Resources Branch utilizes prescribed burning programs to reduce wildfire fuel sources on the Sandhill longleaf pine communities south of TA C-62. The relatively low fuel loads that characterize much of TA C-62 minimize the potential for damaging wildfires generated by CE-EOD open detonation operations. The seepage slope bog habitat along Blount Mill Creek requires frequent fire events to suppress invasion by woody shrubs. Based on a survey of the existing condition of the fire-maintained longleaf pine Sandhill communities to the south of the CE EOD OB/OD unit (including a pristine Tier I community), it is concluded that CE-EOD generated fires have likely benefited impacted Sandhill habitats (Figure 3-11).

#### **Aircraft Gunnery Target TT-3 Maintenance**

The 20 mm aircraft gunnery training TT-3 target maintenance practices have caused severe erosion of the headwater stream slope of Burnout Creek and altered wetland habitats (Burnout Creek Headwater EIA-4, Section 3.4.5). Erosion and sedimentation impacts to EIA-4 are not associated with the direct impact of inert projectiles with the soil surface but of the maintenance of a barren target surface. Over its years of use, the target surface has been kept free of vegetation to allow for pilot target approach recognition and recovery of projectile debris. In years past, recovery machinery similar to golf ball collection equipment was used to periodically retrieve surface gunnery debris.

Unlike TA C-62 targets TT-1, TT-4, and TT-6 that have a bowl-like configuration and minimizes runoff, TT-3 is configured along natural contours. The denuded, eroded condition of the target surface causes it to function like a parking lot during rainfall events. It is estimated that soil is being lost at a rate of ~77 tons/acre/year. Soil has been moved from the site by stormwater runoff and deposited on the stream slope and in the headwater stream channel of Burnout Creek to the south as sediment. Calculations for estimating erosion rates are presented in Appendix C.

No runoff, erosion, or sediment control measures were installed at the site; therefore years of unabated erosion has buried most of the herbaceous plants and covered woody stems with sediment estimated to be up to four feet deep in some locations. Several areas of sediment encroachment of the stream channel were observed. Sediment loading of the stream channel has been substantial enough to create an artificial pond; in other areas the channel is clogged with instream vegetation.

### **Test Area Vegetation Maintenance Roller Drum Chopping**

Potential impacts of roller drum chopping on habitat alteration include damage or destruction of gopher tortoise burrows, accelerated soil erosion, and proliferation of aggressive or invasive species. Roller drum chopping is directly linked to accelerated rates of soil erosion and stream sedimentation on TA C-62. Chopping every other year has diminished the overall vegetative cover on test area lands. Depending on the percentage of ground cover, roller drum chopped land often resembles a plowed agricultural field (Figures 3-45 and 3-46). Reductions in test area vegetative cover that compromise the integrity of the herbaceous layer adversely affects the availability of wildlife food sources, stability of the land to resist erosion, and natural hydrologic processes.

#### *Gopher Tortoise Burrow Collapse*

Although the gopher tortoise is not a federally listed species in northwest Florida, the deep burrows they excavate provide critical habitat for other species including the federally listed threatened eastern indigo snake (*Drymarchon corais couperi*). Roller drum chopping destroys the entrance to a burrow and could cause the collapse of portions of the burrow interior. Generally, gopher tortoises are able to dig out following burrow entrance collapse events in sandy soils (Landers and Buckner, 1981; Diemer and Moler, 1982; Diemer, 1992); however, other species could be entombed within the burrow, depending on the number of trips by the chopper and the extent of burrow collapse.

The tortoise could easily restore active burrows, whereas a destroyed inactive burrow may not be restored, which could diminish associate species' access to burrow habitats. During the 1994 gopher tortoise burrow survey of TA C-62, 14 of the 291 burrows identified were observed to be collapsed with tire tracks across the collapsed entrances. The origin of the tire tracks whether by roller drum chopper rig, bushhogging tractor, or motor vehicle could not be determined.

Habitat degradation and loss is probably the eastern indigo snakes' most important limiting factor. Therefore, the maintenance of tortoise burrow habitats is likely a key component to ensuring the population viability of the eastern indigo snake and other sensitive species on Eglin. Therefore, activities that impact the gopher tortoise population could also impact the availability

of crucial habitats for other species. Gopher tortoise burrow habitat stability is best achieved by eliminating roller drum chopping operations that destroy burrows and nest eggs and kill or injure tortoises.

### *Soil Erosion*

The impact of roller drum chopping on soil erosion potentials is directly related to extent of disturbance to ground cover vegetation (Figures 4-13 and 4-14). The stress and physical disturbance caused by mechanical vegetation management effectively intervenes in the natural progress of native plants towards greater community development and encourages instability toward lesser community development known as retrogression. Retrogression can be destructive to vegetation and habitats, alter soil properties and hydrology, and increase soil erosion potentials. Subsequent soil erosion relocates topsoil and seed resources and inhibits natural revegetation of denuded areas.

Mechanical vegetation management interrupts successional processes in favor of maintaining an ecological state that may exceed species and community tolerances. Some disturbances are minor and transitory, while other disturbances result in unacceptable levels of land degradation that adversely impact the capacity of ecosystems to function.



**Figure 4-13.** Microtopography of small ridges and disturbance of surface vegetation created by roller drum chopper blades can endure for several years.



**Figure 4-14.** Roller drum chopping parallel with slopes increases the erosion potential of stormwater runoff, further reducing vegetative cover and soil stability.

Roller drum chopping can have long-term impacts on native communities because of the repetition and frequency of the disturbance. The cutting blades of the chopper sever and separate native grass root systems and expose roots to potentially hot and/or dry conditions. Frequently the native cover of grasses and forbs is slow to recover from repeated chopping disturbance (Figure 4-19).

Although roller drum chopping is employed as a means of reducing woody species, it is actually instrumental in increasing hardwood populations. The chopped hardwood saplings will likely resprout and the chopping action cuts and replants rootstock that could also produce more plants. Chopper disturbance can also result in pathogen and parasite outbreaks.

*Wildfire Analysis*

Long term roller drum chopping fragments and diminishes fuel sources necessary to carry fire over large areas, which is important to the maintenance of an open, well established herbaceous layer with minimal wood vegetation conditions preferred by the gopher tortoise and complementary of military mission requirements. Roller drum chopping effectively reduces the capacity of grassland species to produce adequate biomass for carrying a fire and increases the density of woody species, which is contradictory to the original intent of the mechanic vegetation control process.

*Biological Invasion*

Exotic (nonnative) weed species such as the invasive Chinese tallow (*Sapium sebiferum*) are known to invade stressed and physically disturbed test areas. The species, also known as the "North Florida Melaleuca," is site competitive, thrives on well-drained uplands and bottomlands, and tends to displace native plants to create monospecific tallow woodlands. Characteristic of woody invaders, it grows rapidly, begins reproduction after only three years, produces abundant viable seed, and can reproduce from cuttings. It also releases compounds that alter soil chemistry and may prevent reestablishment of native species. An exotic species botanical survey has not been performed on TA C-62.

Although the grassland/shrublands of TA C-62 are not considered to be sensitive habitats, the introduction of exotic species to the test area could spread to sensitive habitats on and near the test area. As an example, the introduction of a woody species such as Chinese tallow to the sensitive seepage slope bog along the headwaters of Blount Mill Creek in the southern portion of the test area would quickly degrade this wetland ecosystem. Stream baygall wetlands could also transition to tallow thickets, substantially reducing native species diversity and altering habitat specific hydrology.

Theoretically, Chinese tallow woody materials that end up in Blount Mill Creek from natural causes or from roller drum chopping of nearby areas could be transported by stream flow to the high quality longleaf pine Sandhill Tier I habitat south of TA C-62. Once buried, the woody material sprouts, initiating spread of the species to other areas. The vigorous growth and development of the species can quickly dominate native species, diminishing habitat functions and values. Left unchecked the sensitive Tier I habitat could be transformed into a Chinese tallow thicket understory overtopped by longleaf pines.

*Test Area Roads*

Roads are corridors that connect and disconnect ecosystems, constituting a relatively permanent change in habitat structure for surrounding wildlife. Roads have been associated with a diversity of negative effects on the biotic integrity of both terrestrial and aquatic ecosystems. Roads provide an opportunity for some organisms to move along the road corridor, increasing the connections between habitats intersected by the road. Roads also serve to disconnect ecosystem features by physically isolating some species from moving between habitat requirements or, in the case of wetlands, diverting critical hydrologic features that may alter the succession of wetland communities. Adverse environmental impacts of roads to habitats, wildlife, and hydrology are dramatic, extreme, and well documented (Noss, 1995).



Although test area roads actually occupy a relatively small portion of TA C-62, their contribution to land degradation and alteration of stream morphology and water quality have been dramatic. Introducing a solid structure (soil particles) in a fluid system completely changes the function of the system.

#### *Gopher Tortoise Burrow Collapse Analysis*

It is assumed that the compacted nature of road subgrade deters tortoise burrowing under test area roadways although burrows along road shoulders could be impacted by vehicle traffic. Based on the 1994 TA C-62 tortoise burrow survey, 8 active burrows were within 25 feet of the clay landing strip (Figure 3-18) that also serves as a primary entry onto TA C-62 from the south off RR 210. The presence of active tortoise burrows in such close proximity to the roadway suggests that overall burrow integrity is not adversely impacted by the presence of the road or roadway traffic.

#### *Soil Erosion*

TA C-62 RR380 and test area target TT-6 access roads have had an especially profound impact on wetlands and aquatic ecosystems of Oakie Creek. Oakie Creek Ridge Road (EIA-2) and Oakie Creek North Boundary RR 380 (EIA-3) have been identified as locations of accelerated erosion that have likely contributed thousands of tons of sediment to the Oakie Creek ecosystem. Current soil erosion rates are estimated to be 70 and 110 tons/acre/year for EIA-2 and EIA-3.

Even short-term alterations of flood cycles can have a substantial and long-term effect on wetland vegetation. Minor changes in sensitive wetland hydrology parameters, such as an increase or decrease in average water elevations of a few inches, can also impact the competitive edge of vegetation. Amended wetland hydrology can initiate plant succession from wetland to terrestrial species, which could reduce wildlife habitat availability and utility.

Stream sedimentation can also reduce water quality parameters. Recent sampling of Eglin streams resulted in violations of U.S. Environmental Protection Agency (USEPA) turbidity standards. Eglin turbidity sampling conducted on 23 March 2001 on Middle Creek and an unnamed stream crossing on RR 211 identified each location to be in violation of USEPA turbidity standards (29 Nephelometer Turbidity Units [NTU] over background readings). Middle Creek turbidity was measured at 68.4 NTU and the unnamed stream crossing turbidity was 135.1 NTU (U.S. Air Force, 2000c). Total precipitation in the vicinity of the sampling on 19 March 2001 was 0.98 inches. During turbidity collection, a total of 0.15 inches of rain fell. Water quality data for Oakie Creek was not available; however, it is likely that similar water quality trends are occurring at the Oakie Creek erosion sites EIA-2 and EIA-3.

#### *Wildfire Analysis*

Research indicates that there is a direct correlation between roads and wildfires. While roads have likely increased the occurrence of human caused ignitions in some areas, these same roads have also increased the scale and efficiency of fire suppression by creating firebreaks and avenues of access for fire fighting personnel and equipment. Roads can be readily used for backfiring and burning out operations. However, under severe conditions associated with



intense, rapidly spreading fires, the value of roads for access or as firebreaks is likely to be minimal (Gucinski et al., 2000).

Ignitions caused by humans include burning carbon particles emitted from car mufflers, cigarette butts, burning vehicles, and arson. In a study of the effects of roads on wildfires, Johnson (1963) concluded that over 52 percent of human-caused fires occurred within 33 feet of the road edge. The potential for roads to be a source of wildfires, combined with the difficulty of regulating human use and behavior on or near roads limits options for reducing road related fires risks.

The limited use of test area roads and restricted public access reduces the potentials for road related wildfires on TA C-62. However there is still a remote chance for wildfires to occur particularly during drought periods. Over much of the test area, the sparse vegetative cover could limit the extent of fires. No road related wildfires were identified for TA C-62.

### *Biological Invasion*

The disturbances created by road construction and maintenance form roadside habitats that are susceptible to invasion by various nonnative (exotic) species through dispersion by natural agents (wind and water) and equipment and vehicle operation. The road also creates an edge corridor along which plants can move into the landscape. From the roadside some species may be able to move into interior patches of suitable habitat. Some nonnative species, because of their aggressive nature, can out-compete native species and disrupt the form and function of sensitive plant communities.

Examples of invasive exotic species that occur on Eglin includes is the Chinese tallow, cogangrass (*Imperata cylindrica*), and tropical soda apple (*Solanum viarum*). Seed sources for Chinese tallow and cogangrass are likely the private lands surrounding Eglin, whereas soda apple is likely introduced from hay and/or cattle manure.

### **Alternative 1 and 2 Habitat Alteration Summary**

The primary effector and receptor interactions evaluated in this analysis were TA C-62 air-to-surface inert bomb training, CE-EOD open detonation, test area target and road maintenance mission activities and soil erosion, gopher tortoise burrow habitats, and wildfires. A habitat alteration summary is presented in Table 4-12.

Based on the baseline analysis of air-to-surface inert bomb training expenditures on target TT-1, there are negligible probabilities (<1 percent) of a bomb impacting a gopher tortoise burrow entrance or subsurface portion of a burrow. Because of the potential for gopher tortoises to be in relatively close proximity to CE-EOD open detonation events, there could be a potential for a 2,500 pound NEW detonation event to cause the collapse of a gopher tortoise burrow and entomb tortoises and species located in the burrow chamber; conversely, the existence of these burrows near the open detonation area suggests there is minimal risk to overall burrow integrity. Tortoises, snakes, and frogs in collapsed portions of the burrow near the entrance could probably dig out.

**Table 4-12. Summary of Alternative 2 Potential Habitat Alteration Consequences**

Issue	Mission Activity	Impacts
Air-to-Surface Inert Bomb Delivery Gopher Tortoise Burrow Entrance and Subsurface Impact*		
Probability of entrance collapse by 1,359 BDU-33s striking the TT-1 PBCA	Air-to-Surface Bomb Training	0.3%
Probability of entrance collapse by 303 BDU-50s striking the TT-1 PBCA		0.3%
Probability of subsurface collapse by 113 BDU-50 penetrating the TT-1 PBCA		0.5%
Erosion Impact Areas**		
Blount Mill Creek Headwater EIA-1 - Estimated erosion rate and slope failure soil loss impacting western headwater stream segment of Blount Mill Creek seepage slope bog and stream channel	CE-EOD OB/OD operations	Erosion rate = ~116 tons/acre/year Total slope failure soil loss = ~5,000 tons
Burnout Creek Headwater EIA-4 – Estimated erosion rate and soil loss impacting headwater stream channel of Burnout Creek	TT-3 Target Maintenance	Erosion rate = ~77 tons/acre/year
Oakie Creek Ridge Road EIA-2 - Estimated stream slope erosion rate and soil loss impacting the western headwater stream segment of Oakie Creek baygall wetland and stream channel	Test Area Roads	Erosion rate = ~70 tons/acre/year
Oakie Creek North Boundary RR 380 EIA-3 – Estimated erosion rate and stream slope soil loss associated with unpaved RR 380		Erosion rate = ~110 tons/acre/year
Test Area Maintenance		
Mechanical control of woody vegetation on test area grassland/shrublands every other year	Roller Drum Chopping	Accelerated rates of soil erosion, damage to sensitive species burrow habitats, and promotes the invasion of exotic plant species

\* Probability range is 0 to 100%. Threshold value for a receptor take is 20% with the probability increasing as the value increases.

\*\* Soil erosion equations are presented in Appendix C.

PBCA = Primary Bomb Containment Area

TA C-62 CE-EOD open detonation operations (EIA-1), TT-3 test area target (EIA-4), road (EIA-2 and EIA-3) maintenance activities, and test area maintenance roller drum chopping are facilitating soil erosion and stream sedimentation conditions that are directly impacting a sensitive seepage slope bog and the aquatic habitats of Blount Mill Creek, Oakie Creek, and Burnout Creek. Currently nonrenewable soil resources are being lost at accelerated rates. Continued EIA-1 through 4 land degradation could require the relocation of test areas such as TT-1, TT-3, TT-6, and the permitted CE-EOD OB/OD site and associated groundwater monitoring wells, which are costly in terms of resource expenditures. With regard to the capabilities of test area habitats to absorb and recover from mission impacts, EIA soil erosion and test area maintenance roller drum chopping is adversely impacting the long-term range sustainability of TA C-62.

- The unabated soil erosion from the four primary TA C-62 EIAs that dislodge and transport soils and other surface deposited materials have degraded the form and function of on-site wetland and stream systems and pose a potential risk of adversely impacting off-site wetland and aquatic systems and high quality terrestrial habitats associated with the Tier I longleaf pine Sandhill to the south of TA C-62.

- Current test area vegetation maintenance practices such as roller drum chopping reduce herbaceous biomass production, which increases soil erosion potentials. Although roller drum chopping is employed as a means of reducing woody species, it has actually been instrumental in increasing hardwood densities on TA C-62. Generally roller drum chopping has reduced ground cover fuel loads to levels insufficient to sustain beneficial test area prescribed burns, which assist in controlling hardwoods. Roller drum chopping could also facilitate the introduction of exotic plant species to high quality Sandhill habitats adjacent to TA C-62.
- The destruction of inactive gopher tortoise burrows used by sensitive species such as the federally listed threatened eastern indigo snake (not likely to be restored by tortoises if destroyed) resulting from test area maintenance roller drum chopping could diminish the natural provision of tortoise burrow habitat for sensitive species. Generally, decreases in soil conserving test area grassland/shrubland ground cover caused by roller drum chopping have contributed to diminished quantity and quality of TA C-62 wetland and aquatic habitats.

#### 4.3.2 Alternative 3

The proactive intervention BMPs proposed by Alternative 3 are designed to restore the biological integrity of test area ecosystems in a manner that maximizes the long-term mission servicing capability of test area lands. Special emphasis is placed on utilizing the naturally engineered ability of selected native species to restore damaged and derelict soil environments. A summary of test area habitat sustainability BMPs and document references are presented in Table 4-13.

**Table 4-13. Alternative 3 Range Sustainability Habitat Management BMPs**

Management Category	Environmental Sensitivity Assessment			Recommended BMPs	
	Issues	Document References	Application Area(s)	Practices	Appendix A Reference
Erosion Impact Area Restoration	Accelerated stream slope soil erosion and wetland and stream sedimentation associated with CE-EOD open detonations, road maintenance, target TT-3, and roller drum chopping	Figure 3-36 Figure A-2	Erosion Impact Areas (EIA): <i>EIA-1:</i> Blount Mill Creek CE-EODOB/OD site <i>EIA-2:</i> Oakie Creek Ridge Road <i>EIA-3:</i> Oakie Creek North Boundary RR 380 <i>EIA-4:</i> Burnout Creek Target TT-3	Stream Slope Restoration  Vegetative Runoff Barriers  Oakie Creek Ridge Road (EIA-2) Obliteration and Construction	A-2  A-10  A-12
Grassland/Shrubland Vegetation Management	Areas of sparse vegetative cover primarily associated with roller drum chopping and absence of fire management	Figure 3-11 A-3	All test area grassland/shrublands excluding streams, wetlands, and designated buffer zones	Integrated Vegetation Management System  Hexazinine Herbicide Application  Grassland/Shrubland Prescribed Burning	A-16  A-24
Wetland Habitat Management	Degradation of sensitive seepage slope bogs and stream baygall wetlands associated with sedimentation and absence of wetland fires	Figure 3-11	Headwaters of Burnout Creek, Oakie Creek, and Blount Mill Creek	Stream Slope Restoration Boundary Markers  Wetland Prescribed Burning	A-2 A-26  A-26

The proposed Erosion Impact Area Restoration, Grassland/Shrubland Vegetation Management, and Wetland Habitat Management BMPs outlined in Appendix A and illustrated in Figure 2-1 would serve to:

- Assure compliance with federal and Air Force policies and directives (Clean Water Act, Section 319 and 303(d), and Air Force Instruction 32-7041, Water Quality Compliance).
- Improve habitat conditions on the headwater segments of Blount Mill Creek, Oakie Creek, and Burnout Creek.
- Substantially reduce soil erosion rates to minimal levels (0.3 ton/acre/year) characteristic of native grassland.
- Restore the integrity and viability of the soil environment.
- Protect and conserve high quality seepage slope bog wetlands and off-site Tier I longleaf pine Sandhill habitats.
- Increase the availability of habitat for sensitive species and other wildlife.
- Improve and sustain the long-term capacity of TA C-62 to support (absorb and recover from impacts) military missions.

The restoration of EIAs 1 through 4 would reduce the accelerated soil losses now occurring on the test area. Decades of soil loss have created TA C-62 land areas incapable of supporting military missions. As the size of these unusable land areas continues to increase from unchecked soil erosion, valuable mission testing and training areas will be lost. As an example, the active soil erosion at EIA-1 adjacent to the CE-EOD OB/OD unit may eventually require the relocation of the OB/OD unit. This is an extremely expensive venture since new groundwater monitoring wells and permit would be required; the installation of the existing five monitoring wells cost over \$600,000 to install. Over the long term, the destructive forces of EIA-1 soil erosion could also jeopardize inert bombing target TT-1. Similarly, soil erosion at EIA-2 could result in the loss of target TT-6, and EIA-4 erosion could result in the required relocation of gunnery strafing target TT-3. The restoration of the Oakie Creek Ridge Road (EIA-2) site also includes the obliteration of existing road access to target TT-6 and construction of a road in a low impact area to allow continued access to the target area.

The proposed Alternative 3 test area maintenance program eliminates roller drum in favor of chemical and prescribed burning BMPs that minimize potential impacts to sensitive species and creates conditions amenable to the recovery of damaged terrestrial and aquatic ecosystems. The proposed Integrated Vegetation Management System relies on an initial application of hexazinone (Velpar ULW pellets) herbicide to reduce the density of woody species, followed by prescribed burns that control woody plant growth and density and promote the establishment of native grasses. Based on a recent Eglin Test Area Maintenance Biological Assessment, no adverse impacts to federally listed species or habitats were identified (U.S. Air Force, 2000c). Eglin Natural Resources Branch and the U.S. Fish and Wildlife Service have approved the implementation of the Integrated Vegetation Management System proposed for TA C-62 (U.S. Air Force, 2000d). A detailed discussion of the proposed Integrated Vegetation Management System and a review of the herbicide Hexazinone and its behavior in the environment is presented in Appendix A.

Alternative 3 wetland habitat management techniques are intended to protect sensitive seepage slope bogs and restore or enhance habitat functions of TA C-62 Blount Mill Creek, Oakie Creek, and Burnout Creek stream riparian wetlands. TA C-62 mission related sedimentation of wetlands and stream channels has adversely altered the hydrology and subsequent habitat functions of these ecosystems. Hydrology is characterized as the most important factor controlling wetland structure and function (Taylor et al., 1984). Hydrology is the key to the groundwater recharge, floodwater abatement, shoreline stabilization, sedimentation, nutrient cycling, food chain support, and fish and wildlife habitat functions of wetlands (Larson, 1988). Specifically, stream slope restoration would reduce sedimentation and restore wetland hydrologic regimes; wetland boundary markers would be located upslope of the Blount Mill Creek seepage slope bog to minimize the potential for wetland soil disturbance, and prescribed burning would be used to maintain wetland habitat vegetative diversity and reduce the density of invasive shrubs.

#### 4.3.3 Alternative 4

In addition to the Alternative 3 Range Sustainability BMPs presented in Table 4-13, Alternative 4 proposes a 100 percent increase in the number of air-to-surface practice bombs expended on the test area. Baseline expenditures for BDU-33s would increase from 1,510 to 3,020 inert bombs and BDU-50 expenditures would increase from 337 to 674 inert bombs. Within the analysis parameters of the gopher tortoise burrow collapse scenario presented in Section 4.3.1, the burrow impact probability of a 100 percent increase in air-to-surface inert bomb delivery expenditures is presented in Table 4-14.

**Table 4-14. Summary of Alternative 4 Gopher Tortoise Burrow Entrance and Subsurface Impact Probability**

Impact Scenario	Probability
Entrance collapse by 2,718 BDU-33s striking the TT-1 PBCA	0.5%
Entrance collapse by 606 BDU-50s striking the TT-1 PBCA	0.5%
Subsurface collapse by 226 BDU-50 penetrating the TT-1 PBCA	0.9%

PBCA = Primary Bomb Containment Area

Since all probability values are substantially less than the 20 percent threshold and relatively close to a no-hit probability, there is a negligible probability for a BDU-33 and BDU-50 to damage a burrow entrance and a BDU-50 to impact subsurface burrow walls and cause a collapse of the burrow interior within the target TT-1 PBCA.

#### 4.3.4 Habitat Alteration Summary

Conservative analysis of the potential for air-to-surface inert bomb training to impact and damage the entrance or subsurface portions of a gopher tortoise burrow identified negligible probability of impact to be less than one percent. The Range Habitat Sustainability BMPs proposed by Alternative 3 could substantially reduce soil erosion, seepage slope bog habitat degradation, and stream sedimentation of Blount Mill Creek, Oakie Creek, and Burnout Creek. A summary of habitat alteration for Alternatives 1 through 4 is presented in Table 4-15.

**Table 4-15. Alternative 1 through 4 Habitat Alteration Summary**

Environmental Analysis		Alternatives		
Expenditure/Scenario	Criteria	1 and 2	3*	4
<b>Air-to-Surface Inert Bomb Impacts</b>				
Probability of gopher tortoise burrow entrance collapse	Probability of a tortoise burrow hit is 0 to 100%. Threshold value for a take is 20%.			
BDU-33s		0.3%	0.3%	0.5%
BDU-50s				
Probability of subsurface gopher tortoise burrow interior collapse from BDU-50 impact		0.5%	0.5%	0.9%
<b>Erosion Impact Area (EIA) Soil Erosion Impacts</b>				
CE-EOD Open Detonation Operations: Blount Mill Creek Headwater EIA-1	Tons of soil loss/acre/year	~116 tons/acre/year	~0.3 tons/acre/year	No Change
Aircraft Gunnery TT-3 Target Maintenance: Burnout Creek Headwater EIA-4		~77 tons/acre/year		
Test Area Roads Oakie Creek Ridge Road EIA-2		~70 tons/acre/year		
Oakie Creek North Boundary RR 380 EIA-3		~110 tons/acre/year		
<b>Grassland/Shrubland Vegetation Maintenance*</b>	Stable soil and herbaceous ground cover on acres impacted	Increased soil erosion and woody vegetation and reduced herbaceous ground cover on ~1,163 acres	Reduce soil erosion and woody vegetation and increase herbaceous ground cover capable of supporting beneficial prescribed burns on ~1,163 acres	No Change

\* Based on the implementation of Range Sustainability Best Management Practices (BMPs) outlined in Appendix A

#### 4.4 DIRECT PHYSICAL IMPACT

Direct physical impact (DPI) occurs when an effector strikes humans, wildlife, or cultural resources. Weapon systems testing and training activities frequently produce projectiles, fragments, and debris that could cause physical injury or death to biological receptors or damage to cultural resources. For TA C-62, direct physical impacts from air-to-surface bomb delivery training, aircraft gunnery training, missile ground training, and CE-EOD open detonation operations are analyzed. The impacts of vegetation management equipment on biological and cultural resources are discussed in the Test Area Maintenance PEA (U.S. Air Force, 1999) and are not a part of this analysis.

##### 4.4.1 Alternative 1 (No Action) and 2 (Authorize Current Level of Activity)

Refer to Habitat Alteration (Section 4.3), Table 4-8 for a summary of air-to-surface bomb training, 20 mm aircraft gunnery training, and 35 mm M190 missile ground training baseline mission expenditures. A summary of the CE-EOD open denotation mission expenditure baseline is presented in Table 4-3.

## Environmental Analysis

The performance of mission activities on TA C-62 results in varying types of surface disturbance caused by the impacts of inert bombs, missiles, and gun ammunition projectiles with the surface and ground cratering associated with CE-EOD open detonation operations. The bulk munitions materials expended on the test area were comprised primarily of metals such as steel and iron and composite materials (plastics, synthetics, etc.). The ordnance metal debris and projectiles are of greatest concern to DPIs on TA C-62. Because the test area is cleared of nonmilitary personnel prior to the initiation of mission activities, there is minimal chance of fragments or debris hitting humans. The TA C-62 potential sensitivities to direct physical impact are identified in the following sections.

### *Sensitive Species*

The potential exists for striking plants and wildlife, including the gopher tortoise (*Gopherus polyphemus*) and Florida burrowing owl (*Speotyto cunicularia floridana*). No direct threat was identified for the burrowing owl in the Oakie Creek area, so the species is excluded from further analysis. Of additional concern to this analysis is the potential for mission activity projectiles, fragments, and debris to destroy incubating gopher tortoise nest eggs. Tortoise nesting on TA C-62 occurs primarily from May through mid-June. The female typically lays a single annual clutch of between 1 and 25 eggs to an average depth of four inches in the burrow spoil mound or apron within one foot of the burrow. Incubation ranges from 80 to 110 days (Wilson et al., 1997).

### *Cultural Resources*

Although buried and near-surface archeological features receive some protection from direct impacts by vegetation and soil overburden, there is the potential for surface disturbance caused by air-to-surface bomb delivery and gunnery training and the cratering blast effects of CE-EOD open detonations. Currently, Eglin mandates that detonations occur at least 200 meters away from streams on TA C-62 to minimize potential impacts to cultural resources. However, surface disturbance mission activities are currently being performed within cultural resource constraint zones on TA C-62. On the test area, cultural resource constraint zones encompass the lands within 200 meters of streams that are designated as zones of potential high probability for the presence of prehistoric and historic archaeological sites.

The aircraft gunnery target TT-3; air-to-surface bomb delivery targets TT-1, TT-4, and TT-6; and the CE-EOD open detonation/open-burn operations area occur within cultural resource constraint areas. Historically, air-to-surface target areas were disked to increase the contrast of the target area with the surrounding landscape for aerial approach recognition purposes. Three flight approach lanes to target TT-1 are also regularly disked through Oakie Creek cultural resource constraint areas to sustain landscape contrast effects (Figure 4-15).



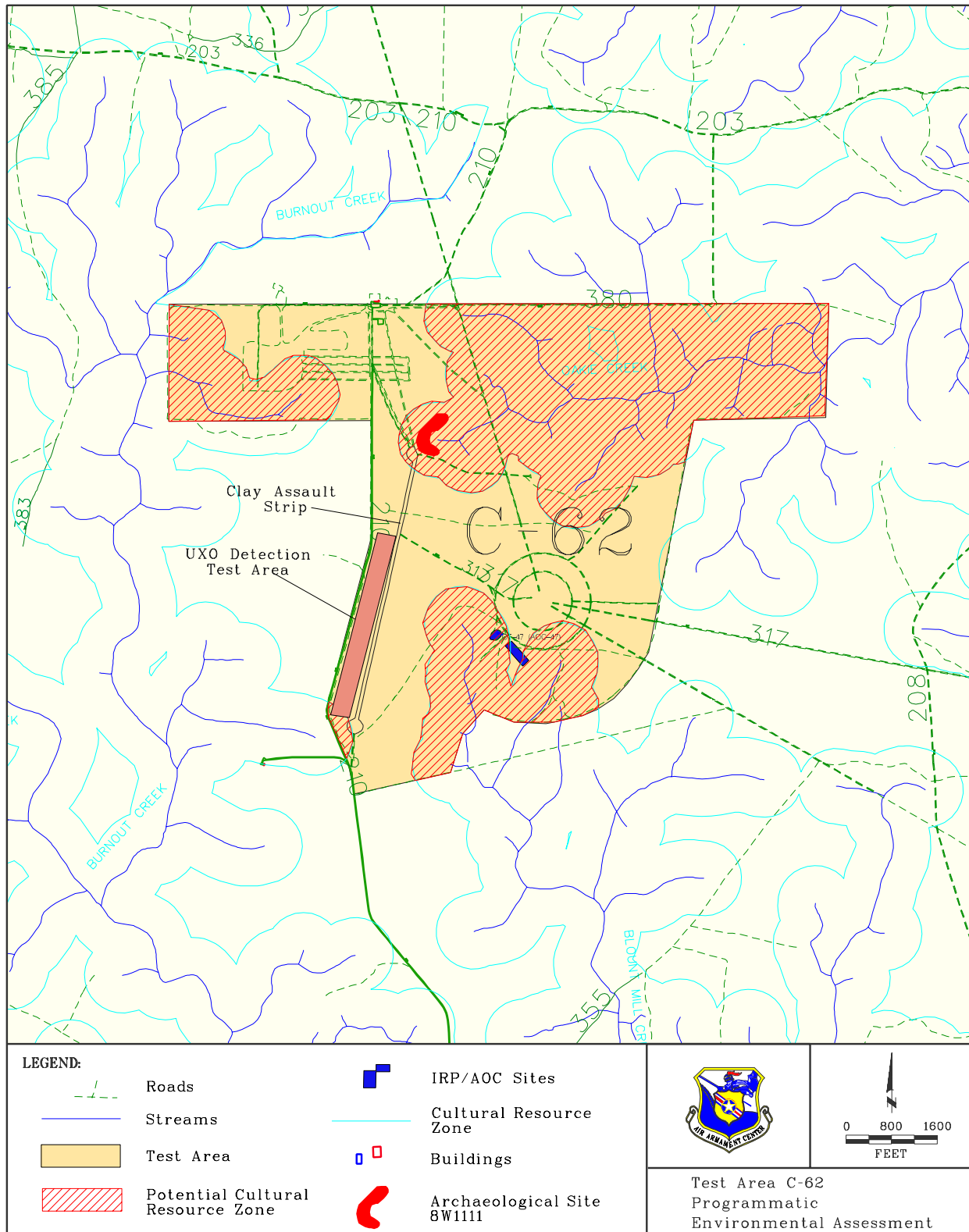


Figure 4-15. Target Areas and Cultural Resource Constraint Zones

A prehistoric site (Site Number 8WL111) has been recorded on TA C-62 at the headwaters of Oakie Creek (Figure 4-3). A recent investigation by an AAC/EM archaeologist revealed that the site has been destroyed by soil erosion and is no longer considered significant. Two prehistoric sites were identified during a survey of the Blount Mill Creek headwater area in the southern portion of the test area. The sites were relatively undisturbed. Investigation of the Burnout Creek headwater produced nothing of Cultural concern (U.S. Air Force, 2001c). No mission related DPI cultural resource impacts are anticipated.

### ***Direct Physical Impact Environmental Impact Screening***

The potential interactions between current mission activities and ecological and cultural resource sensitivities of special concern that are the focus of this analysis are identified in Table 4-16.

**Table 4-16. Potential Direct Physical Impact Effector and Receptor Interactions**

Mission Activity	Biological Sensitivities		
	Gopher Tortoise	Commensal Tortoise Burrow Species	Tortoise Nest Eggs
Air-to-Surface BDU-33 and BDU-50 Bomb Delivery Training	✓	✓	✓
20 mm Aircraft Gunnery Training	✓	✓	✓
35 mm M190 Missile Training Ground Operations	✓	✓	✓
CE-EOD Open Detonation Operations	•	•	•
Test Area Roads	•	•	—*
Test Area Maintenance Roller Drum Chopping	✓	✓	✓

✓ = Potential impact

• = Minimal impact

— = No potential impacts

\* Assumes vehicles remain within roadway

The ecological and mission component interactions important to this analysis include:

- Location and density of sensitive species that occur within the targets' weapon impact area and overlap of target weapon impact area and cultural resource zones. Estimated size, weight, velocity, and targeted distribution of mission activity projectiles, fragments, and debris.
- Extent and frequency of test area maintenance roller drum chopping.
- Frequency and duration of mission event expenditures.

The rationale for excluding CE-EOD open detonation activities and test area roads from further DPI analysis is as follows:

- The analysis of fragment hazards resulting from the open detonation of explosive materials is considerably less developed than techniques for predicting explosion blast wave damage. Generally, the investigation of fragment effects requires a probabilistic approach primarily related to the dynamics of randomness involved in metal fractures and

trajectories. This results in broad variations in possible fragment size and mass distributions of the same type weapon under identical conditions that diminishes metric data confidence and utility.

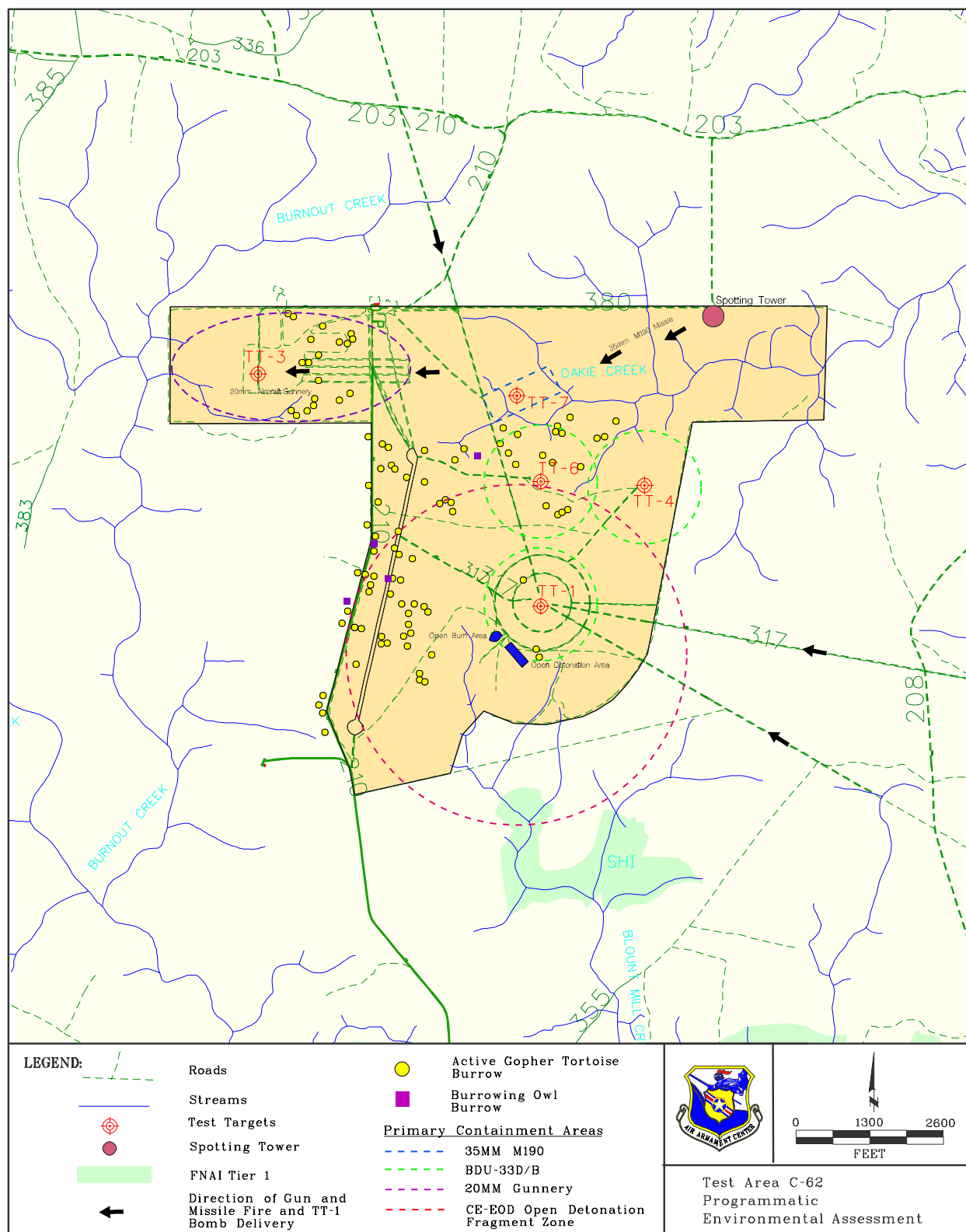
- The 2,500 pounds of explosive material under evaluation as a conservative explosive package scenario includes a live MK-84 high fragmentation bomb that is designed to provide a combination of high fragment density (number of fragments per unit area) and mass. It is assumed that the relatively small size of most fragments created by the detonation of a 2,500-pound explosive package would minimize receptor exposure to deadly impacts. The largest probable fragment would likely be the MK-84 10-pound base.
- Ground-based sensitive species and tortoise nest eggs could receive a level of protection from standing vegetation and the terrain. A more probable route of exposure would involve burrowing owls that fly into the estimated 3,000-foot diameter fragment footprint at the time of detonation. Flying birds would not be afforded protection and would likely encounter fragments at maximum densities and velocities.
- Test area roads could create conditions conducive to impacts between gopher tortoises and commensal tortoise burrow species and vehicles. However based on the infrequent use and low density of active test area roads, the potential direct physical impact to individual species crossing roads is considered minimal assuming vehicles remain within the confines of the roadway.

In the following sections, the potential impact interactions of BDU-33 and BDU-50 bomb deliveries, 20 mm aircraft gunnery, and 35 mm M190 missile activities and ecological sensitivities are evaluated. Estimated mission activity impact footprints used in this analysis are shown in Figure 4-16.

### ***Air-to-Surface BDU-33 and BDU-50 Bomb Delivery Training***

This section evaluates the potential for a bomb to inflict physical injury and/or death to the gopher tortoise or commensal burrow species (Appendix C) and adversely affect tortoise-nesting success by destroying clutch eggs. A conservative scenario for analyzing the potential probability of a BDU-33 and a BDU-50 delivered to target TT-1 to impact tortoises and commensal burrow species is based on the following assumptions:

- The BDU-33 and BDU-50 bomb delivery mission and footprint parameters and gopher tortoise density projections are the same as presented in the Gopher Tortoise Burrow Collapse Scenario in Habitat Alteration (Section 4.3).
- The 76 BDU-50s that skip on the surface within the Primary Bomb Containment Area (PBCA) impact the surface a total of three times before coming to rest. The initial, direct impact of a BDU-33 or BDU-50 would kill contacted individuals and destroy all eggs in the nest.
- A BDU-50's contact with the surface during skipping is considered lethal to individuals and nest eggs. The point of impact that is considered lethal for the BDU-33 is the first time the bomb strikes the ground; skipping contacts would not be lethal or damage nest eggs.



**Figure 4-16. Gunnery, Bomb Delivery, and Missile Training Primary Impact Footprints and CE-EOD Open-Detonation Fragmentation Zones**

- Each active burrow within the PBCA is occupied by one or more commensal species throughout the year.
- A receptor take would include DPI impacts to one of three receptor groups including:
  1. Gopher tortoise
  2. Multiple or single commensal burrow species
  3. Nest egg clutches
- Gopher tortoises, commensal burrow species, and nest eggs are exposed to DPI outside the burrow.
- The average home range of a gopher tortoise on TA C-62 is one acre with 80 percent of their time spend within 30 feet of the burrow.
- Burrow impact analysis is based on a receptor take probability scale of 0 to 100 percent. For the purpose of this analysis, the threshold value for a receptor take is 20 percent with the probability increasing as the value increases.

The air-to-surface bomb delivery training DPI probability for gopher tortoise, commensal burrow species, and tortoise nest egg clutches receptor takes are presented in Table 4-17. The calculations used to estimate potential air-to-surface bomb delivery DPI impacts are presented in Appendix C.

**Table 4-17. Estimated Air-to Surface Bomb Delivery Sensitive Species DPI Take Probability\***

Burrow Impact Scenario	Probability (%)
1,359 BDU-33s striking PBCA	0.30
303 BDU-50s striking PBCA	0.10
76 BDU-50s striking PBCA and 3 skips per bomb within the PBCA	0.10

Sensitive species = gopher tortoise, commensal burrow species and/or gopher tortoise nest egg clutches

### **20 mm Aircraft Gunnery Training**

For the baseline, 13,731 rounds of practice 20 mm TP M99 were expended on target TT-3. A graphic of a 20 mm round similar to the M99 is presented in Appendix D. The mission and footprint parameters for 20 mm gunnery training on TA C-62 are presented in Table 4-18. DPI analysis of 20 mm projectiles impact potentials follows the conservative scenario parameters as presented under *Air-to-Surface BDU-33 and BDU-50 Bomb Delivery Training*, this section. The target TT-3 PPCA contains approximately 6,354,000 square feet or 146 acres. For the baseline expenditure of 13,731 20 mm TP rounds, 12,358 projectiles (90 percent) are evenly distributed within TT-3 (Figure 4-16). Lethality from a projectile impact occurs within 0.5 feet of the burrow entrance, and projectile ground skips are not considered lethal.

**Table 4-18. Target TT-3 20 mm Aircraft Gunnery Training Mission and Footprint Parameters**

Mission Parameters		Footprint Parameters (feet)	
Aircraft	F-15/F-16	Long (down range)	9,275
Event	Low Angle Strafe	Short (back range)	650
Target	Soft	Cross Range	850
Dive Angle	-5 to -15 degrees	Maximum Cross Range	2,320
Altitude Release	2,000 to 2,600 feet	Runway Gun Limit	12,246

Source: U.S. Air Force, 1987

The 20 mm aircraft gunnery training DPI probability for gopher tortoise, commensal burrow species, and tortoise nest egg clutches receptor takes are presented in Table 4-19. The calculations used to estimate potential 20 mm aircraft gunnery training DPI impacts are presented in Appendix C.

**Table 4-19. Estimated 20 mm Aircraft Gunnery Sensitive Species DPI Take Probability\***

<b>Burrow Impact Scenario</b>	<b>Probability (%)</b>
One 20 mm projectile striking TT-3 PPCA	0.00009
12,358 20 mm projectile striking TT-3 PPCA	1.1

\*Sensitive species = gopher tortoise, commensal burrow species and/or gopher tortoise nest egg clutches

It has also been discovered that there may be a remote possibility of direct physical impacts to red-cockaded woodpeckers (RCW) associated with TA C-62 aircraft gunnery training. In 1993, a 20 mm projectile was found lodged in the bottom of a RCW nest cavity chamber approximately 5,490 feet west of TA C-62 along RR 381. The end portion of the 20 mm round was protruding between eggs that had been laid on the tree cavity. No damage to the eggs or structural integrity of the nest was observed.

Based on the type of projectile and location of the nest tree in relation to the target TT-3 aircraft gunnery strafing area, it was determined that TA C-62 was the likely source of the projectile. That same year Natural Resources Branch, Jackson Guard personnel had a projectile impact the road approximately 50 in front of their vehicle during a RCW cluster survey; other projectiles could be heard impacting timber in the surrounding area. No injuries occurred. Following this incident the TA C-62 aircraft gunnery training safety footprint was expanded to include the area in proximity to RR 381.

In 1993, the impacted tree was one of several active trees that made up the RCW cluster. In November 2001, there is only one active RCW cavity tree remaining in the cluster; the majority of the trees have died or nests were abandoned. No direct correlation between the loss or abandonment of active cluster trees and TA C-62 aircraft gunnery missions were identified (U.S. Air Force, 2001e).

### **35 mm M190 Ground Training**

During the baseline period, the Hurlburt Small Arms Range Complex used TA C-62 target TT-7 for 35 mm M190 missile training. The missiles were shoulder-launched from a location close to the northeast-spotting tower at the metal vehicle replicas at TT-7. For the baseline expenditure of 2,002 M190 practice missiles fired at target TT-7, 1,802 missile projectiles (90 percent) were evenly distributed within the target TT-7 Primary Projectile Containment Area (PPCA) containing approximately 656,000 square feet or 15 acres (Figure 4-16). Lethality from a projectile impact occurs within 0.5 feet of the burrow entrance and projectile ground skips are not considered lethal. The 35 mm M190 missile raining DPI probability for gopher tortoise, commensal burrow species, and tortoise nest egg clutches receptor takes are presented in Table 4-20. The calculations used to estimate potential 35 mm M190 missile training DPI impacts are presented in Appendix C.

**Table 4-20. Estimated 20 mm Aircraft Gunnery Sensitive Species DPI Take Probability\***

Burrow Impact Scenario	Probability (%)
One 35 mm M190 projectile striking PPCA	0.00009
1,802 35 mm M190 projectiles striking PPCA	0.20000

\*Sensitive species = gopher tortoise, commensal burrow species and/or gopher tortoise nest egg clutches

### ***Test Area Maintenance Roller Drum Chopping***

Direct contact with 5 to 8 ton roller drum choppers would likely kill or cause a fatal injury. Direct contact of choppers with a gopher tortoise nest would likely destroy all nest egg clutches. Even the cushioning effect of the sandy soils would do little to alleviate the cutting action and/or pressure applied by the drum choppers. In areas with a high density of hardwood saplings, choppers are often pulled in tandem. Based on the density of standing hardwood saplings, multiple passes may be made over the same area, which increases DPI potentials. The federally listed threatened eastern indigo snake (*Drymarchon corais couperi*) is known to use active and inactive gopher tortoise burrows such as those identified on TA C-62. The fact that the snake is large, docile, and relatively slow increases the risk of direct impact by drum choppers. Burrowing owls and Florida pine snakes (*Pituophis melanoleucus*) are also known to use tortoise burrows.

Roller drum chopping potentially impacts sensitive species in two distinct DPI venues:

- 1) species contact with chopper blades during test area maintenance operations and
- 2) impacts to test area gopher tortoise populations.

It is evident that declines in test area gopher tortoise populations could impact seasonal habitat availability for sensitive species. Choppers could also kill or injury sensitive species traveling between habitats or during escape efforts (Figure 4-17).

Maintenance of gopher tortoise populations that maintain burrow habitats preferred by the eastern indigo snake and other sensitive species is best achieved by eliminating roller drum chopping operations that destroy tortoise burrows and nest eggs and kill or injure tortoises.



**Figure 4-17. Gopher Tortoise**

It is estimated that there is a 100 percent receptor take probability associated with TA C-62 roller drum chopping operations. Roller drum chopping also likely contributed to the destruction of archaeological site 8WL111 at the headwater of Oakie Creek.

### **Alternative 1 and 2 Direct Physical Impact Summary**

The potential DPI effector and receptor interactions evaluated in this analysis included air-to-surface bomb delivery, 20 mm aircraft gunnery training, 35 mm M190 missile training, and test area maintenance roller drum chopping and the gopher tortoise, commensal burrow species, and gopher tortoise nest egg clutches.



Since all mission projectile DPI potential probability values are substantially less than the 20 percent threshold and relatively close to a no-hit probability (<1 percent), there is a negligible probability for the baseline delivery of air-to-surface inert bomb delivery, 20 mm aircraft gunnery training, and 35 mm M190 ground training to result in a take of a gopher tortoise or commensal species, or to destroy tortoise nest egg clutches. Assuming full coverage of approximately 1,163 acres by roller drum choppers, it is concluded that contact between choppers and receptors would likely result in a 100 percent probability of species death or serious injury and destruction of gopher tortoise nest eggs. A direct physical impact summary is presented in Table 4-21.

**Table 4-21. Summary of Alternative 2 Potential Direct Physical Impact Consequences**

Mission Expenditure	Probability*		
	Gopher Tortoise	Commensal Species	Tortoise Nest Egg Clutch of 25 Eggs
<b>Air-to-Surface BDU-33 and BDU-50 Training</b>			
<b>1,359 BDU-33s Striking within the Target TT-1 PBCA</b>	0.3%	0.3%	0.3%
303 BDU-50s striking within the target TT-1 PBCA	0.1%	0.1%	0.1%
76 BDU-50s striking within the target TT-1 PBCA and skipping three times	0.1%	0.1%	0.1%
<b>20 mm Aircraft Gunnery Training</b>			
12,358 20 mm projectiles striking within the target TT-3 PPCA	1.1%	1.1%	1.1%
<b>35 mm M190 Missile Training</b>			
1,802 35 mm missiles striking the target TT-7 PPCA	0.2%	0.2%	0.2%
<b>Test Area Maintenance</b>			
Roller Drum Chopping	100%	100%	100%

\* Probability range is 0 to 100%. Threshold value for a receptor take is 20% with the probability increasing as the value increases.

PBCA = Primary Bomb Containment Area

PPCA = Primary Projectile Containment Area

#### 4.4.2 Alternative 3

The proposed Alternative 3 Integrated Vegetation Management System (Table 4-13) would eliminate the potential for DPI associated with roller drum chopping by excluding this practice from further use on TA C-62. Mechanical test area vegetation management has been identified as a relatively ineffective means of controlling woody species and is a primary contributor to the degradation of mission support landscape platforms and ecosystem mission impact absorption and recovery capabilities. Proposed direct physical impact BMPs are presented in Table 4-22.

**Table 4-22. Alternative 3 Range Sustainability Direct Physical Impact Best Management Practices**

Management Category	Environmental Sensitivity Assessment			Recommended BMPs	
	Issues	Document References	Application Area(s)	Practices	Appendix A Reference
<b>Grassland/Shrubland Vegetation Management</b>	Areas of sparse vegetative cover primarily associated with roller drum chopping and absence of fire management	Section 3.4.6. Page 4-59 Figure 3-11	All test area grassland/shrublands excluding streams, wetlands, and designated buffer zones	Integrated Vegetation Management System	A-16
				Hexazinone Herbicide Application	A-16
				Grassland/Shrubland Prescribed Burning	A-24

No direct physical impacts associated with the proposed Integrated Vegetation Management System were identified. A detailed discussion of the fate and transport potentials of the herbicide hexazinone is presented in Appendix A.

#### 4.4.3 Alternative 4

Alternative 4 includes Alternative 3 BMPs plus a 100 percent increase in the baseline number of air-to-surface bomb delivery training, 20 mm aircraft gunnery training, and 33 mm M190 missile ground training. Within the analysis parameters of the mission activity impact scenarios presented in Section 4.4.1, the probability of direct physical impacts of a 100 percent increase in bomb delivery, gunnery, and missile training are presented in Table 4-23.

**Table 4-23. Summary of Alternative 4 Potential Direct Physical Impact Consequences**

Mission Expenditure	Probability*		
	Gopher Tortoise	Commensal Species	Tortoise Nest Egg Clutch of 25 Eggs
<b>Air-to-Surface BDU-33 and BDU-50 Training</b>			
<b>2,718 BDU-33s Striking within the Target TT-1 PBCA</b>	0.5%	0.5%	0.5%
606 BDU-50s striking within the target TT-1 PBCA	0.1%	0.1%	0.1%
152 BDU-50s striking within the target TT-1 PBCA and skipping three times	0.1%	0.1%	0.1%
<b>20 mm Aircraft Gunnery Training</b>			
24,716 20 mm projectiles striking within the target TT-3 PPCA	2.2%	2.2%	2.2%
<b>35 mm M190 Missile Training</b>			
3,604 35 mm missiles striking target TT-7 PPCA	0.3%	0.3%	0.3%
<b>Test Area Maintenance</b>			
Hexazinone Application and Prescribed Burning	0%	0%	0%

\* Probability range is 0 to 100%. Threshold value for a receptor take is 20% with the probability increasing as the value increases. PBCA = Primary Bomb Containment Area; PPCA = Primary Projectile Containment Area

It is estimated that there is a negligible probability of direct physical impact to a gopher tortoise, tortoise burrow commensal species, or tortoise nest egg clutch take associated with a 100 percent increase in TA C-62 air-to-surface inert bomb training, 20 mm aircraft gunnery training, and 35 mm M190 ground operations. DPI probability is likely reduced further by the disturbed condition of the target surface. As an example, the area around the aircraft gunnery targets at TT-3 is denuded of vegetation, which would reduce its value as a preferred gopher tortoise habitat (Figure 4-18).



**Figure 4-18. TT-3 Aircraft Gunnery Training Targets**

It is also theorized that the soil-binding root systems of vegetation may play a role in the stabilization of surface portions of burrows dug in loose soils such as the Lakeland sand on TA C-62.

#### 4.4.4 Direct Physical Impact Summary

Conservative DPI analysis of the potential for air-to-surface inert bomb training, 20 mm aircraft gunnery training, and 35 mm missile ground operations to impact a gopher tortoise, commensal species or gopher tortoise nest egg clutch for all alternatives identified negligible impact probabilities for the baseline mission expenditures. A summary of DPI for Alternatives 1 through 4 is presented in Table 4-24.

**Table 4-24. Alternatives 1 through 4 Direct Physical Impact Summary<sup>a</sup>**

Environmental Analysis		Alternative Receptor Take Probability <sup>b</sup>		
Expenditure	Criteria	1 and 2	3	4
Air-to-Surface inert bomb training	Threshold value for a receptor take is 20%	0.3%	0.3%	0.5%
20 mm aircraft gunnery training		1.1%	1.1%	2.2%
35 mm M190 missile ground operations		0.2%	0.2%	0.3%
Test Area Maintenance		100%	0%	No Change

<sup>a</sup> Probability range is 0 to 100%.

<sup>b</sup> Receptor take= gopher tortoise, commensal species, or gopher tortoise nest egg clutch impact by mission expenditure.

## 4.5 CHEMICAL MATERIALS AND DEBRIS

This section provides an analysis of potential environmental impacts associated with chemical materials and debris. Because of direct linkage, similar impact contribution potentials, and analysis overlap, these two issues are assessed jointly. Chemical materials are the constituents or by-products of effectors that can cause chemical changes to a physical receptor or toxicological effects to a biological receptor. The chemical materials of concern to this analysis are the particulate matter, gases, and other residues expended during mission activities. A review of fate and transport models for chemical materials in the environment is found in the *Effector Analysis Report* (U.S. Air Force, 1996d).

For the purpose of this analysis, debris is the surface and/or subsurface accumulation of unexploded ordnance (UXO) created by the expenditure of inert and live munitions and other energetic materials. Expended items may remain intact following impact with the surface or may be fragmented into smaller pieces. There is the potential for live and inert surface and subsurface UXO debris to contribute to chemical materials potential through exposure of unexpended explosive chemical materials from ruptured or corroded bomb or projectile casings. A detailed discussion of TA C-62 UXO is presented in Section 3.4.3.

### 4.5.1 Alternative 1 (No Action) and 2 (Authorize Current Level of Activity)

Refer to Table 4-3 for a summary of the CE-EOD open detonation baseline expenditures. In the environmental analysis that follows, the air emission, metals, and other chemical residuals generated by CE-EOD open detonations will be analyzed with respect to potential impacts to air, soil, and water quality and biological resources. Chemical materials exposures to the public are not anticipated since individuals are not allowed entry to the test area during mission activities,

and virtually all testing activities are performed by remote control with mission personnel a safe distance away.

### **Chemical Material Environmental Analysis**

The thermal degradation (combustion) of explosive ordnance materials as expended during CE-EOD open detonations may generate chemical by-products that under certain concentrations may exceed biological thresholds. The purpose of this analysis is to identify the chemical materials generated by mission expenditures and assess the relationship between expenditure chemical material concentrations and threshold criteria.

Chemical by-products could expose biological receptors (flora and fauna) to concentrations of air, water, and/or soil-borne chemical materials that may adversely impact the well-being and reproduction success of species. The long-term repetition of ordnance expenditure at the same locations can increase the potential for chemical materials to accumulate in soils or aquatic resources at concentrations that could exceed threshold levels. In the following discussion, the mission performance capabilities are analyzed and the chemical materials threshold criteria and analysis methods are described.

### ***Mission Performance Analysis***

The TA C-62 CE-EOD open detonation operations area has a history of heavy use for the disposal of Eglin's explosive munitions materials. For the baseline period, the principle ordnance materials disposed of during TA C-62 CE-EOD open detonation events include small arms ammunition, practice and high explosive warhead gun ammunition, inert and live bombs, missile and rocket motors, flares, smoke devices, M 30 propellant, various explosives, and other miscellaneous explosive materials. All materials were open detonated in explosive packages containing less than 3,000 pounds of explosive material (Table 4-3). Up to two detonation events are conducted 10 minutes apart within the 200 x 400 foot open detonation area in pits approximately 300 feet apart. There are five groundwater-monitoring wells located on the site that are monitored quarterly. The features of the CE-EOD open detonation and burn area are presented in Figure 4-19. The metals, particulate matter, and gaseous by-products resulting from the thermal degradation of selected primary waste ordnance propellants and explosives are the focus of the CE-EOD open detonation analysis.

The methodology selected to evaluate the potential impacts of TA C-62 CE-EOD activities on air quality includes:

- Establish a conservative scenario for a TA C-62 Ammunition Disposal Requisition mission event that represents a peak exposure potential.
- Create a simulated enclosure that represents the volume of space where exposures to peak emission concentrations are likely to occur.
- Identify a timeframe during which peak concentrations could persist within the simulated enclosure.
- Calculate an estimated peak exposure concentration for the enclosure/timeframe scenario.

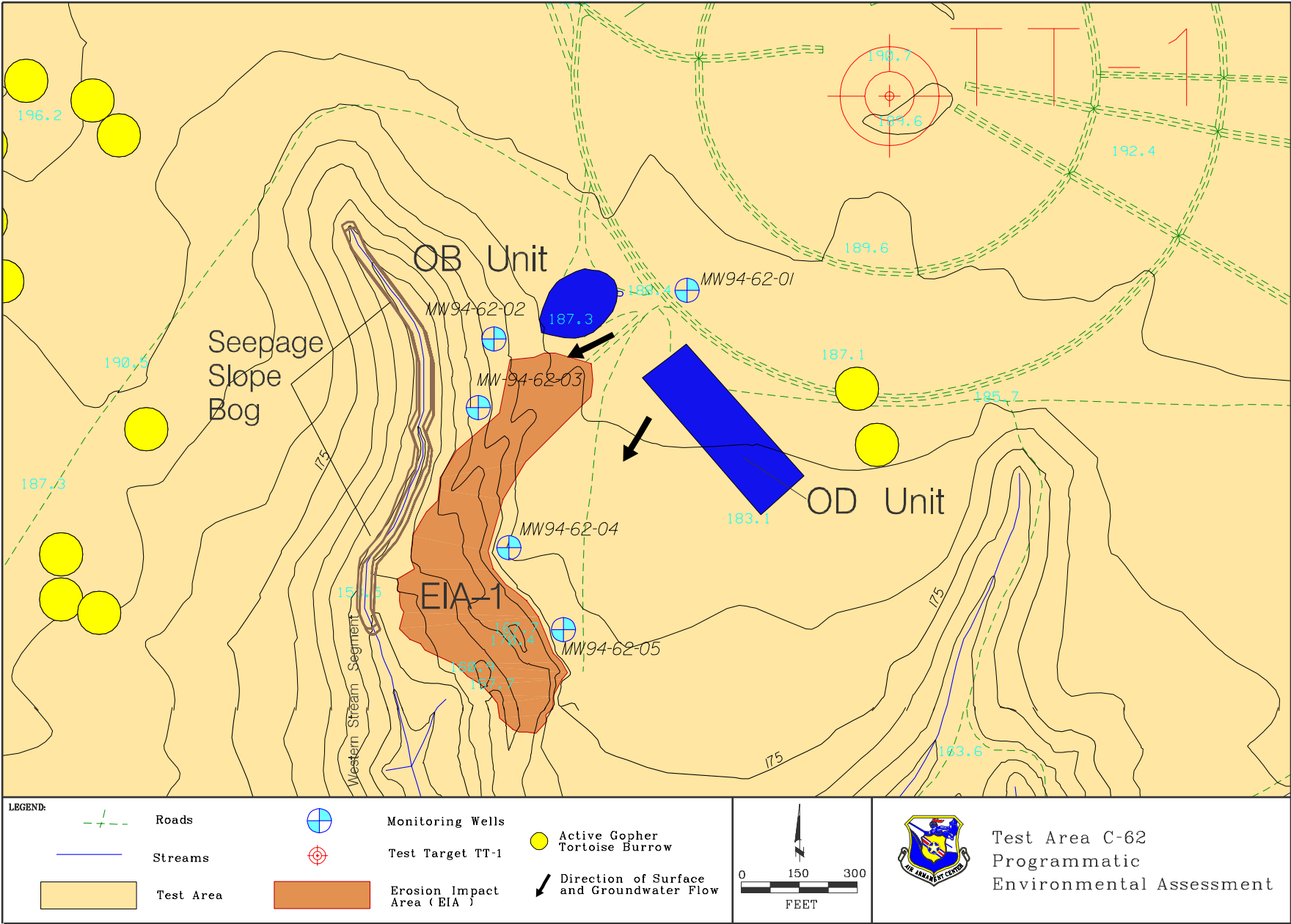


Figure 4-19. TA C-62 CE-EOD OB/OD Area

For the purpose of environmental analysis, mission-specific scenarios are crafted to convey a realistic portrayal of pollution potentials that realistically account for what is probable as well as what is possible. Typical activities and conditions associated with the performance of a mission event may be emphasized beyond what would normally occur to account for possible atypical mission events and to identify the potentials for pollutant concentrations to exceed threshold criteria. As an example, mission activities for this analysis are generally evaluated as occurring only under unfavorable weather conditions, and the timeframes between expenditures may be condensed to reflect a possible but unlikely frequency of a mission event expenditure or circumstance.

### ***Air Quality***

The peak concentration enclosure selected for air quality analysis is cone-shaped. For the applications of this environmental analysis, it is proposed that the cone enclosure represents a more realistic distribution of air emission concentrations compared to a box or cylinder. The wide base of the cone surrounding the point-of-origin and the vertical reduction in enclosure volume reflects the potential change in air emission concentrations resulting from atmospheric dilution and dispersion. It is also assumed that the “ground cloud” that occupies the enclosure contains all emissions generated by the mission event or activity under analysis.

The ground cloud generated by the mission expenditure(s), which is warmer than the surrounding air due to the heat of combustion, will initially rise and drift as it cools. It would eventually reach a stabilization altitude, cooled to the point where it would no longer rise, but disperse while continuing to drift. Part of the cloud would eventually reach the ground and ultimately disperse to the point of having no measurable impact on ambient air quality.

Once air-borne pollutants are generated, the process of atmospheric mixing, dilution, and dispersion can quickly alter the extent and duration of pollutant peak concentrations. Weather conditions have a direct bearing on the impact of air-borne pollutants on air quality. The capability and expediency by which the atmosphere is able to disperse and thereby reduce air emission concentrations is primarily dependent on temperature inversions and wind conditions. The most unfavorable weather conditions on Eglin for pollutant dispersal occur during the months of July and August when calm winds (less than four miles per hour) and temperature inversions at 300 feet and less blanket the atmosphere and limit the vertical movement and mixing of air-borne pollutants generated at the surface. Under these conditions, the extent and duration of localized concentrations could temporarily increase.

A discussion of air quality pollutants, parameters, and concentration-based standards is presented in Chapter 3, *Affected Environment*.

### ***Soil Quality***

The concept of soil quality is a balance of sustained biological productivity, environmental quality, and plant and animal health. Since soils vary in their capacity to function, the definition of quality will be specific to each kind of soil (Doran and Parkin, 1994). An alteration in the quality of soils on TA C-62 could alter the capacity of the soils to sustain crucial ecological

functions, which could diminish the military support capabilities of the test area and adversely impact the environment.

Many of the chemical material by-products deposited on the surface following mission activities naturally occur in the soil. However, there is the potential of mission activity by-products to accumulate in the soil at concentrations that may exceed the buffering capacity of the soil or may adversely impact biological receptors. Chemical material soil concentrations resulting from mission expenditures will be estimated. The criteria for assessing soil concentration during the environmental consequences analysis are discussed in the following narrative.

Metals such as lead that can be a component of explosives and propellants are included in this analysis. Primer mechanisms usually contain lead styphnate, and some types of ammunition may contain lead azide or lead styphnate as an ingredient of the energetic material. Other metals such as copper and aluminum may also be a constituent of ordnance material. There may be an extensive degree of variability in the metals composition of the energetic material primarily based on the type and manufacturer of the material. For the purpose of this analysis, the lead composition of ordnance items is derived from the MIDAS database. If data for the exact type of ordnance is not available, the lead composition of a similar type of munitions is used.

Metals are natural elements that typically occur at low concentrations and are important to life support systems and overall ecosystem function. The behavior of pollutants in the soil is a function of the physical and chemical properties of the pollutant and the soil. The environmental problems associated with metals relate to the fact that metals, unlike organic materials, cannot be degraded or destroyed. The concentration of metals in uncontaminated soil is primarily related to the geology and parent material from which the soil was formed.

The immobilization of metals prevents the leaching of metals into groundwater systems by mechanisms of adsorption and precipitation. Metals adsorption by soil is related to properties of the pollutant and properties of the soil such as clay content, organic content, texture, permeability, pH, particle size, surface area, ion exchange capacity, water content, and temperature. The soil components that are most associated with immobilization of metals are clay, iron oxides, and organic matter. The soil particle surface characteristics thought to be most important to adsorption are surface area and cation exchange capacity (CEC). Immobilized metals in surface soils that are prevented from entering groundwater can be readily transported to receiving waterways by the soil erosion process.

The U.S. Environmental Protection Agency Region III has developed risk-based criteria (RBC) for over 500 chemical compounds. The primary purpose of the RBC is for screening chemicals during risk assessments. Risk is defined as the expected frequency or probability of undesirable effects resulting from exposure to known or expected chemical stressors that could induce an adverse response in biological receptors. RBC concentrations have been calculated for tap water, ambient air, fish tissue, and industrial and residential soil, and are represented as cancerous or noncancerous effects.

As in air quality analysis, a conservative scenario is generated to estimate the potential concentration of pollutants in soil. For analysis of soil concentrations, the potential cumulative amount of pollutant generated by mission activities over a mission event or the entire three-year



baseline period is calculated. Whereas the peak concentration of air-borne pollutants is attained for a relatively short period of time, soil concentrations may accumulate over time and persist for extended periods. For the purpose of this analysis, Region III RBC concentrations for industrial soil will be used as the threshold levels for chemical materials generated by mission activities. The RBCs used in this analysis do not constitute federal regulation or guidance and should not be viewed as a substitute for a site-specific ecological risk assessment.

Since contaminant soil concentration potentials are a component of the environmental analysis, an estimated volume ( $\text{g/cm}^3$ ) has been developed for the Lakeland soils that dominate the CE-EOD open detonation area and primary region of influence. Soil particle density is the mass per unit volume of the solid particles, minus air and water spaces. In the absence of site measurements, the dry weight density of potentially impacted sandy soil is  $1.7 \text{ g/cm}^3$ .

### *Water Quality*

Water quality analysis will focus on the potentials for chemical material by-products to enter the headwater stream segments of Blount Mill Creek to the south of the CE-EOD open detonation area. The potential contaminant transport systems include surface runoff and groundwater recharge. In general, the climate and physical and chemical nature of the Lakeland soils that dominate the area under review make them prone to relatively rapid contaminant infiltration and leaching through the soil profile into groundwater.

### *Groundwater*

Over time, all aquifer systems underlying Eglin AFB are susceptible to anthropogenic contamination with the Surficial Aquifer (SA) being particularly vulnerable because of the short flow path length from the land surface to the water table and the frequently minimally confined natural water table of the SA. Susceptibility to contamination is generally defined by the hydraulic conductivity of the geological medium along the relevant groundwater flow path and the flow path length. Low hydraulic materials provide increased resistance to water flow, which decreases the average velocities associated with contaminant time-of-travel; the inverse is true for substrate materials with high hydraulic conductivity (Pratt et al., 1996). The Lakeland soils that dominate TA C-62 are characterized by greater than 90 percent quartz sand and very high hydraulic conductivity (permeability) of 20 to 28 inches per hour.

Of particular importance to this analysis of TA C-62 groundwater contamination potentials is the dominance of quartz sand in the substratum and geologic layers. Although groundwater-monitoring wells have been established in proximity to the CE EOD OB/OD unit in the southern portion of the test area, no site-specific aquifer geohydrology testing has been performed. However even though there is potentially a high degree of variability in the horizontal and vertical lithology of aquifer sediment layers, the SA in northwest Florida generally has similar textures of fine to medium sand interbedded with varying amounts of clay and primarily flows laterally discharging at nearby surface water features such as streams and wetlands.

A general understanding of the characteristics of the TA C-62 SA can then be derived from an aquifer study near Milton, Florida, to the north of Eglin AFB. The Northwest Florida Water Management District performed aquifer testing at the Milton T-Field Airport in Santa Rosa

County in 1978 as part of the Evaluation of Industrial Water Availability Study. The primary purpose of the study was to determine the hydraulic characteristics of the highly productive SA, which serves as a primary source of groundwater (Richards, 1998). Test boring data is summarized in Table 4-25. The transmissivity (rate of groundwater flow expressed in units of length squared over time) of the full thickness of the aquifer was estimated to be 10,200 ft<sup>2</sup>/day.

**Table 4-25. Milton T-Field Surficial Aquifer Soil Boring Data**

Depth (feet)	Thickness (feet)	Description
0-53	53	Sand, medium to coarse; yellow and red clay near top of unit
53-70	17	Sand, as above, but medium to medium-coarse, with little clay
70-85	15	Sand, coarse to very coarse and pebbly, also white clay
85-135	50	Sand, medium to coarse, sub-angular, with white and red clay; few coarse grains
135-225	90	Sand, as above, generally coarser and cleaner
225-230	5	Sand, loose, medium to medium-coarse, sub-angular, with muscovite flake and phosphate grains, gray clay

The prevalent trend identified in this data set is the dominance of sand materials throughout the SA profile with incidental occurrences of clayey materials. Even where clay materials did occur the overall texture was still classified as sand rather than a sandy clay, clayey sand, or clay. The yellow and red clays identified near the surface are similar to the Citronelle geologic layer clayey materials identified at Erosion Impact Area – 1 near the CE-EOD OB/OD unit. These near-surface clayey layers account for the existence of perched water tables and other aquitards that promote greater lateral migration of groundwater flows toward stream and wetland discharge points.

### *Surface Water*

Potential declines in the water quality functions of TA C-62 stream riparian and seepage slope wetlands are also a concern. As areas of transition between terrestrial (grassland/shrublands) and aquatic environments (stream channels), wetlands provide a wide range of valued water quality functions. Associated with the loss or decline of wetland ecosystems is a termination or degradation in the function attributes of ecosystems.

In broad terms pollutants may be removed from water by extracellular enzymatic breakdown, ion-exchange on soil surfaces, biological uptake, or adsorption by clay particles (Wilkinson and Schneller-MacDonald, 1987). Specific wetland functions important to this analysis are materials retention and transformation. However the processes affecting the retention and transformation of pollutants in wetland are poorly understood.

Retention is defined as the process acting to remove the contaminant from the inflowing water. Transformation is the process whereby the form or outward appearance, condition, nature, or function of matter is changed. Retention and transformation processes are controlled by physical (sorption, volatilization, particle filtration, sedimentation), chemical (precipitation, hydrolysis, complexation), and biological (biodegradation, biotic uptake) (Odum, 1978). The primary retention processes of wetlands are high roughness coefficients of plant biomass, flora and fauna uptake characteristics, and chemical properties associated with anaerobic sediments. Dense surface vegetation promotes uniform distribution of water flow across the wetland and provides

extensive area for attachment of biological growths that play an important role in water quality enhancement. As wetland types vary, so does their ability to retain organic and inorganic inputs.

### ***Biological Resources***

Biological resource impact potentials will focus on sensitive species and habitats. The sensitive species potentially exposed to chemical materials on TA C-62 include the gopher tortoise and Florida burrowing owl. A Florida Natural Areas Inventory Tier I Sandhills habitat type is located about 1,000 feet to the south of TA C-62 along Blount Mill Creek. Chemical material exposures from CE-EOD open detonations could impact the ecological condition of the sensitive habitat. Exposure to chemical materials includes air-borne emissions and particulate matter and ingestion of chemicals directly or indirectly through bioaccumulation in food chain.

Vegetation may be adversely impacted by the deposition of chemical material by-products on plant surfaces or uptake by root systems. Where applicable, contaminant concentrations that result in a measurable reduction in plant growth and yield as calculated by Suter et al. (1993) will be presented. In the sections that follow, the environmental consequences of chemical by-products generated by CE-EOD open detonation and aircraft gunner training activities for the baseline period FY95 through FY96 on the air, soil, water quality, and biological receptors associated with TA C-62 are identified and analyzed.

### **Debris Environmental Analysis**

TA C-62 surface and subsurface unexploded ordnance (UXO) debris is associated with present-day CE-EOD OB/OD operations, air-to-surface bomb testing and training, high performance aircraft gunnery training, and missile and rocket ground training operations and other historic operations. TA C-62 has a long history of primarily inert munitions testing and training, which is still considered UXO because they may contain a small amount of explosive known as a spotting charge. However, there is the potential for historic surface and subsurface high explosive UXO materials to be within and beyond the boundaries of TA C-62.

Debris can be measured in terms of number of items deposited over time, volume, or weight per unit area (pounds per acre), surface area covered (square feet), or potentially hazardous or obstructive areas displaced for other uses. Some types of debris, such as plastic, may present specific hazards to certain types of animals. Aesthetic impacts (i.e. visually unattractive) for non-hazardous debris are relative according to the uses of the area affected.

Debris criteria do not exist in terms of the number of items or weight allowed or prevented by law. There are federal initiatives laws that may be relevant to the mission related deposition of items on DoD lands. The Defense Science Board Taskforce on UXO has concluded that contamination and UXO on active test areas is a problem for DoD. As a result, a DoD UXO policy is under development by the Deputy Under Secretary of Defense, Environmental Security, that will likely require managers to maintain a UXO inventory, formalize a test area management planning process, conduct periodic assessments of UXO and other constituents conditions, and maintain accurate records (Goodman, 1998).

Due to their complexity and varied functions, military munitions may contain constituents that may be a concern to the TA C-62 environment (Figure 4-20). Munitions may be composed of propellants, explosives, and pyrotechnics; chemical agents; metals; and other inert components.

Over time, potential UXO material casings exposed at the surface or buried in the ground could corrode and expose energetic chemical compounds to the soil environment. UXO chemical materials could also be exposed to groundwater by infiltration through the soil and to surface water by runoff. No stream surface water or TA C-62 soil sampling data were available. Explosive residues have been detected in CE-EOD OB/OD site groundwater monitoring wells.



**Figure 4-20. Ruptured MK-82 Bomb Casing**

### **CE-EOD Open Detonation Chemical Material Impact Potentials**

For the baseline period FY95 through FY97, the open detonation area was used to dispose of approximately 40,674 lb NEW of munitions. A summary of mission expenditures for the baseline period is presented in Table 4-3 beginning on page 4-6. Open burning is excluded from this analysis because baseline burn data were not available and CE-EOD is investigating the adoption of other alternatives to open burning because of the technical difficulties and environmental impact potentials associated with the process.

In the sections that follow, a conservative Ammunition Disposal Requisition (ADR) open detonation mission event scenario for estimating peak chemical material impact potentials is created and possible implications to air quality, soil quality, water quality and biological resources are evaluated.

#### ***Mission Event Impact Scenario***

A conservative scenario for evaluating the potential environmental impacts of chemical materials generated by a CE-EOD ADR open detonation mission event is as follows:

- An ADR mission event to dispose of 5,000 pounds of explosive material is divided into two explosive packages of 2,500 pounds that will be detonated 10 minutes apart within the TA C-62 open detonation area in separate detonation pits.
- The ordnance components of a 2,500-pound explosive package are identified in Table 4-26.
- Expended propellants and explosives contain item-specific amounts of lead in the form of lead styphnate, or lead azide per pound of energetic material.
- All explosive package energetic materials undergo complete thermal degradation at the time of detonation.

**Table 4-26. Simulated TA C-62 CE-EOD 2,500-Pound Explosive Package Ordnance Components**

Ordnance	Unit Quantity	Total Explosive Material (Net Explosive Weight in Pounds)		Quantity of Lead Compounds (lbs)
		Propellant	RDX Explosive	
MK-84 Bomb	1 Bomb	0	945	0.009/bomb
M-30 Propellant	450 Pounds	450	0	0.00004/pound
20 mm HEI	1,745 Rounds	150	50	0.0003/round
40-mm HEI	100 Rounds	115	87	0.0001/round
HBX Explosive	450 Pounds	0	450	0.0001/pound
BBU-36/B Impulse Cartridge	45,455 Cartridges	0	100	0
M-206 Flare	350 Flares	0	100	0
C-4	53 Pounds	0	53	0

Source: MIDAS Database

- Peak exposure concentration will occur within a cone 213.36 meters (700 feet) wide at the base and 91.44 meters (300 feet) high and a volume of 1,090,000 m<sup>3</sup> positioned over the center of the open detonation area as an emission point-of-origin (Figure 4-19).
- The longest duration of peak concentration within the cone is 15 minutes.
- Unfavorable weather condition of calm winds and a 300-foot inversion extend throughout an open detonation mission event.

The CE-EOD open detonation mission event scenario represents an estimated peak air emission concentration for a 2,500-pound explosive package. The amounts of carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and lead (Pb) generated by the detonation of an explosive package are calculated by multiplying the amount of explosive energetic material by an emission factor. Calculations are then performed to determine peak exposure concentrations for the cone enclosure. The estimated by-products and potential exposure concentrations for the detonation of a mission event 2,500-pound explosive package are presented in Table 4-27.

**Table 4-27. Estimated Peak Concentration of Air Emissions Generated by the Detonation of a 2,500-Pound Explosive Package**

Ordnance Materials	Criteria Pollutant								
	Emission Factor			Total Emission By-product/Explosive Package Detonation					
				Total Emission (grams)			Exposure Cone Peak Concentration and NAAQS Standards		
	CO (lb/lb)	NO <sub>2</sub> (lb/lb)	Lead (lbs)	CO	NO <sub>2</sub>	Lead	CO 40 mg/m <sup>3</sup>	NO <sub>2</sub> 100 µg/m <sup>3</sup>	Lead 1.5 µg/m <sup>3</sup>
MK-84	0.0047	0.00015	0.009	2,015	64	4	2.0	60	4
M-30	0.0015	0.00010	0.014	306	20	8	0.2	15	6
20 mm	0.1100	0.00047	0.524	907	43	238	9.0	40	220
40 mm	0.0210	0.00047	0.010	191	41	5	0.2	4	4
HBX	0.0052	0.00004	0.035	1,061	8	20	0.8	6	15
BBU-36/B	0.0084	0.00061	0.000	381	277	0	0.4	250	0
M-206	0.0083	0.00280	0.000	377	127	0	0.4	117	0
C-4	0.2300	0.00024	0.000	5,529	6	0	5.0	5	0
<b>Explosive Package Emission By-product</b>				<b>10,767</b>	<b>586</b>	<b>275</b>	<b>18.0</b>	<b>497</b>	<b>249</b>

### *Air Quality*

Chemical materials primarily in the form of carbon monoxide, nitrogen dioxide, and lead were introduced to the environment of TA C-62 by CE-EOD open detonation mission events. The estimated peak concentrations of carbon monoxide were substantially less than NAAQS standards. Based on the mission event impact scenario, there is the potential for nitrogen dioxide and lead emissions to momentarily exceed NAAQS air quality standards. National and Florida air quality standards are discussed in detail in Section 3.4.8.

It is anticipated that dynamics of atmospheric dilution and dispersion, although somewhat limited by the unfavorable weather conditions, would dilute and disperse the air pollutants within a 15-minute timeframe. The dynamics of air emission concentrations in ambient air are quite variable and are primarily governed by the physical and chemical parameters of mission event expenditure activities and the prevalent weather conditions. Changes in weather and mission parameters could drastically alter the actual concentration potentials of each mission event.

It is concluded that the airborne lead emission estimates for mission events on TA C-62 are within timeframe tolerances for single event expenditures and that the actual measured post-event concentration will vary dramatically based on mission and climatic variables. There is the potential for open detonation by-products to impact the surface waters of the western stream headwaters segment of Blount Mill Creek and groundwater resources.

### *Soil Quality*

No adverse impacts to soil quality from CO or NO<sub>2</sub> emissions generated by open detonations were identified. The analysis of potential lead concentrations in the soil resulting from a 5,000-pound ADR mission event is based on the following assumptions:

- Of the 550 grams of lead particulate emitted by the mission event (detonation of two similar 2,500-pound explosive packages), 50 percent or 275 grams will be deposited on the land surface to an average depth of 0.0508 meters (2 inches) within an exposure area 213.36 meters (700 feet) in diameter positioned over the center of the open detonation area as a central point-of-origin. The total volume to the exposure cylinder is 1,816 m<sup>3</sup>. The remainder of the lead emission will remain suspended for an undetermined period and not be deposited within the exposure area.
- The average bulk density of the sandy soils in the exposure area is estimated to be 1.7 g/cm<sup>3</sup>.
- The particulate lead by-product materials deposited on the surface of the exposure area require little or no chemical degradation to become mobile in the soil solution or be immobilized by soil constituents and are susceptible to surface movement by erosion.
- Unfavorable weather conditions of calm winds and a 300-foot inversion existed throughout an open detonation mission event.

Within the parameters of the open detonation mission event defined above, the total estimated mission event soil concentration of lead is 0.1 mg/kg. These estimated lead concentrations are substantially less than the 39.64 mg/kg background concentration for Eglin's surface soils and

substantially less than the U.S. Environmental Protection Agency Region III Risk-Based Criteria (RBC) of 400 mg/kg.

### *Water Quality*

Current open detonation operations are prone to deposit explosive chemical residues on the land surface. The depth of open detonation pits also creates conditions that could directly expose groundwater to explosive residues.

### *Surface Water*

The existence of a severely degraded EIA-1 landscape barren of vegetative cover or other mechanisms for resisting the forces of soil erosion adjacent to the CE-EOD OB/OD unit substantially accelerates the potential for nonpoint source pollution of receiving waters. Post open detonation event chemical residues and particulate matter suspended in stormwater runoff or attached to sediments provide a direct link to the potential contamination of on- and off-site streams and wetlands. Many of the EIA-1 gullies and sediment bars at the EIA-1 toe-of-slope are laden with a “beach-soft” layer of sediment that contains the directly deposited (explosive package blast distribution) and transported munitions debris by-products of open detonations.

Based on a review of the CE-EOD OB/OD unit and EIA-1 mission effectors, landscape condition, geohydrology, and groundwater sampling data, it is concluded that the western headwater segment of Blount Mill Creek and the seepage slope bog wetlands are likely being directly exposed to explosive residues from direct open detonation blast deposition and surface runoff. No stream or wetland water sampling data were available.

### *Groundwater*

Potential routes of TA C-62 CE-EOD OB/OD unit groundwater contamination include direct exposure of the water table and physical susceptibility of the Surficial Aquifer to surface contamination mitigated by a generally sandy texture throughout and very high hydraulic conductivity. As presented in Habitat Alteration, Section 4.3, exposure of the water table at the bottom of the pit following a detonation event creates a direct exposure route for chemical by-products to enter the groundwater system. Investigation of the detonation pit shown in Figure 4-11 exhibited evidence of potential chemical by-products that cover the blast-excavated soils along the perimeter of the pit and the pit walls (example: white area on pit wall in Figure 4-11). These materials are easily suspended in runoff and transported off-site or moved directly into the exposed water table at the bottom of the pit. Pit water or wall sampling data were not available.

As discussed in Chapter 3, Affected Environment, TA C-64 CE-EOD open detonation unit groundwater monitoring detected 2,4-dinitrotoluene at concentrations that exceeded Florida drinking water standards and nitroglycerin and 4-amino-2,6-dinitrotoluene at concentrations four times greater than the Method Detection Limit. Detection of exceedences for nitroglycerin and 4-amino-2,6-dinitrotoluene in the upgradient background monitoring well (MW94-62-01) suggest that sources of contamination other than the CE-EOD OB/OD unit, such as historic unexploded ordnance, may exist. Results of tumor bioassays in rats suggest that pure

2,4-dinitrotoluene (2,4-DNT) is not carcinogenic; however, study limitations preclude a definitive statement regarding carcinogenicity. Based on toxicity studies of rats, the recommended 2,4-DNT water quality criteria to achieve a human health risk of 10 sup-5, 10 sup-6, or 10 sup-7 are 1.7, 0.17, and 0.017 µg/L, respectively; the 2,4-DNT used in the toxicity studies was 98 percent pure. Based on chronic studies, a water quality criterion for nitroglycerin of 0.01 mg/L (24-hour average) has been recommended (Environmental Laboratory, 1998).

Based on the variable dynamics of thermal degradation, performance of CE-EOD open detonation events at the open detonation unit on TA C-62 since 1994, potential contribution to groundwater concentrations by other sources such as UXO, and diversity of possible munitions combinations contained in a mission event explosive package, a quantifiable metric for correlating open detonation event scenarios to groundwater concentrations of nitroglycerin, 2,4-dinitrotoluene, and 4-amino-2,6-dinitrotoluene is not available.

The presence of a seepage slope bog adjacent to the western headwater segment of Blount Mill Creek down gradient of the detonation pits suggests that there may be a perched water table underlying the permitted detonation unit. An underlying perched water table could accelerate the horizontal and reduce the vertical migration velocity of explosive by-products dissolved in groundwater and promote lateral movement along groundwater contours towards the seepage slope bog and stream channel (Figure 4-19). The relatively slow movement of water through the ground means that residence times in groundwater is generally orders of magnitude longer than in surface waters. Wetland water sampling data were not available.

Based on groundwater monitoring data and the geomorphic and geohydrologic features of the area, it is concluded that groundwater borne explosive by-products are likely migrating toward the western headwater stream segment and seepage slope bog of Blount Mill Creek. The severely eroded condition (loss of surface soils) of EIA-1 and subsequent absence of vegetative cover reduces the time-of-flow required for contact between contaminants and groundwater.

### ***Biological Resources***

Atmospheric dilution and dispersion is estimated to drastically reduce elevated nitrogen dioxide and lead air emissions concentrations within 15 minutes, even under unfavorable weather conditions. Estimated soil lead concentrations were not identified as a threat to individual species or bioaccumulation in the food chain. Metals are not included in the CE-EOD OB/OD permit approved groundwater sampling protocol. The seepage slope bog along the western headwater of Blount Mill Creek and groundwater seepage flow into the creek establishes a direct link between groundwater contaminants and aquatic flora and fauna. Analysis of potential impacts of explosive materials exposure to aquatic organisms is presented in Table 4-30.

### **Debris Impact Potentials**

Surface water and groundwater quality and biological resource impact potentials associated with debris entail current TA C-62 baseline mission activities as well as the historic delivery of unrecovered surface and subsurface UXO munitions. The historic delivery of live munitions on



TA C-62 and CE-EOD OB/OD operations has been identified as a potential UXO safety hazard and source of soil and water contamination.

### *Water Quality*

Debris associated with historic UXO and CE-EOD OB/OD operations have been identified as potential sources of water quality impairment. In the following sections, groundwater, surface water, and biological resource impact potentials associated with historic UXO are analyzed.

### *Groundwater*

There is evidence that historical UXO may be impacting TA C-62 groundwater quality. Groundwater sampling of CE-EOD OB/OD unit background monitoring well MW94-62-01 detected concentrations of the explosive residues nitroglycerin, RDX, 1,3-dinitrobenzene, 3-nitrotoluene, and 4-amino-2,6-dinitrotoluene. Only nitroglycerin concentrations exceeded screening levels (Table 3-8). This is important because the monitoring well is up gradient of the CE-EOD open detonation unit. This means that groundwater flows are moving from the background well toward the open detonation unit. Explosive residues detected in the groundwater likely originated from a location north of the open detonation unit.

Based on the historical reference of a potential for high explosive UXO in the southern portion of TA C-62 (Section 3.4.3), it is theorized that historical TA C-62 bomb deliveries buried at impact without detonating and corrosion of the bomb casings (fabricated outer part of ordnance designed to hold explosive charge and mechanism required to fire such charge) over the decades may be exposing explosive chemical materials to the soil environment. Over time, munition chemical constituents exposed to the soil environment could migrate into groundwater.

It is generally understood that perforated high explosive munitions casings could release energetic materials into the soil profile and facilitate explosive material dissolution and transport. However it not known whether bombs, warheads, or other round casings that enter the soil and do not explode are in pristine condition, pitted and corroded, or are cracked before coming to rest in the soil. Regardless of soil conditions, munition seals used to contain explosive charges may loosen or disintegrate, releasing materials into the soil.

Explosive materials released from casings into the soil may also present an explosive hazard. Fillers, propellants, explosives, and other constituents leached into the soil and/or groundwater degrade and commingle creating a potentially explosive environment. Synergistic effects of commingled explosives may actually increase the probability of an uncontrolled detonation. Detonation could occur as a result of friction, impact, pressure, heat, or flames (U.S. Environmental Protection Agency, 2001). Contact between the metal casings of an at-rest UXO and delivered ordnance could create a spark, which in the vicinity of commingled explosives could result in a detonation event. Fires generated by wildfires and controlled burns could also ignite exposed UXO chemical materials.

In subsurface soil environments, transformation and sorption are the most important environmental processes affecting the fate and transport of 2,4,6-trinitrotoluene (TNT). For hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and other explosives, additional processes such as

mineralization to CO<sub>2</sub> are important, whereas sorption is less important (Brannon and Myers, 1997). Based on existing information, there is the potential for TA C-62 surface and subsurface UXO to contribute to the detection of explosive residues in CE-EOD site groundwater monitoring wells because of the:

- Historic use of live munitions especially in the southern portion of the test area
- Soil and climate variables that foster the corrosion and oxidation weathering of munitions metal casings
- Potential deficiencies in test area soils to absorb and transform explosive residues

In general, the likelihood of UXO degradation in the soil depends on the integrity and thickness of the munitions metal casing. The condition of surface and subsurface TA C-62 UXO regarding at-rest casing exposures of explosive residues from cracking, pitting, and/or breakage is unknown; however, there are known metal corrosion and test area soil and climate variables that may impact the perforation of at-rest metal UXO casings and fate of exposed explosive materials. Ordnance metal casing corrosion processes are discussed in Appendix F.

Iron and steel are the primary bomb and projectile metal casing materials that likely comprise TA C-62 surface and subsurface UXO. There are comparatively few differences between the corrosion processes of iron, steel, and numerous alloy steels. Although historic burial pits containing unexploded bombs have been discovered on other Eglin test areas such as TA B-75, no munitions burial pits are known to exist on or in proximity TA C-62.

#### *Test Area Soils Metal Corrosion Potentials*

The soils of TA C-62 have a direct bearing on the potential for the corrosion and perforation of UXO metal casings and the fate of explosive material exposures because of inherent physical and chemical characteristics and hydraulic attributes. The capacity of munitions to penetrate the surface also effects metal corrosion and chemical exposure potentials. The following discussion analyzes soil penetration resistance, UXO metal casing corrosion, and UXO explosive materials transport potentials associated with TA C-62 soil environments.

#### Soil Penetration Resistance

Penetration resistance (measured as megapascals, 1 Mpa = 10 bars) is defined as the capacity of the soil in its confined state to resist penetration by a rigid object (Boulding, 1994). High penetration resistance is an indication of soil compaction, low water content, or other soil features that impede vertical movement. The U.S. Army investigated several methods for estimating the penetration of ordnance into the earth and subsequently developed a methodology, database, and model for estimating ground penetration depths for various munitions and environmental condition scenarios (Crull et al., 2001). Since UXO detection and recovery are outside the scope of this analysis, test area specific munition penetration depth modeling was not conducted.

Generally ordnance items can penetrate clay with greater ease than sand; however the degree of penetration is strongly dependent on soil moisture content. A dry clay soil can become almost

impenetrable, whereas a moist/wet clay soil is relatively easily penetrated. The high water holding capacity of fine textured clays could reduce ordnance penetration friction compared to coarse textured sand, which has a low water holding capacity. Examples of ordnance soil penetration depths are presented in Table 4-28.

**Table 4-28. Depths of Ordnance Penetration into the Soil**

Type of Munition	Ordnance Item	Depth of Penetration (feet)		
		Sand	Clay	Soil Containing Vegetation
Projectile	155 mm M107	14.0	28.0	18.4
	105 mm M1	7.7	15.4	10.1
	75 mm M48	4.9	9.9	6.5
	37 mm M63	3.9	7.9	5.2
Rocket	2.36" Rocket	0.4	0.8	0.5

Source: USEPA, 2001

Soil type influences the depth to which UXO may penetrate as well as whether the fuze will activate. Some fuzes require a substantial impact before they will activate. Generally magnetic and proximity fuzes are considered the most sensitive and pull-friction and pressure fuzes are considered the least sensitive. If the munition lands in a “soft” soil area, the fuze may not detonate the munition. Such conditions could also increase the likelihood and potential density of UXO materials (Federal Advisory Committee for the Development of Innovative Technologies, 1996). It is important to reiterate that this analysis is focused on the historic delivery of live munitions during the 1940s through the 1960s and not the predominately inert munitions delivery testing and training operations of the last 30 years.

The physical properties of the sandy Lakeland soils that occupy most of TA C-62 are classified as low to slight soil compaction potential and are estimated to have moderate penetration resistance. TA C-62 penetrometer measurements of soil compaction were not available; however, site investigations found no evidence of near surface soil compaction other than test area roadbeds. Vertical resistance is further reduced by the general absence of soil hardpans and rocky soil layers. The primary limiting factor of ordnance penetrating TA C-62 Lakeland sand is its low water holding capacity; low soil moisture equates to increased friction as ordnance items move through the soil.

The estimated moderate penetration resistance of TA C-62 soils could have resulted in the penetration and lodging of bombs and projectiles in lower layers of the soil profile. The bomb or projectile vertical velocity, angle of repose at the point of ground impact, and munition features and delivery mechanism also influence whether the item was buried or remains on the surface. The potential presence of a localized aquitard (relatively water impermeable subsurface soil layer) could have impeded or in some cases increased item ground penetration potentials, as could be the case with a wet clay lens. The presence of a seepage slope bog to the west of the CE-EOD OB/OD unit signifies the potential presence of a perched water table aquitard feature; soil tests were not performed to determine the presence of aquitards on other areas of TA C-62. Habitat alteration analysis estimated the maximum depth of penetration of a 500-pound BDU-50 to be 20 feet.

The potential for munition impacts with the soil to result in the breakage or cracking of an item is not known. The historic density of surface and subsurface UXO could also have played an important role in the breakage or rupturing of ordnance metal casings as would be the case with high velocity contact between a delivered munition and surface or subsurface at-rest objects. Regardless of its conditions once at rest, the chemistry and constituents of the soil immediately began to interact with exposed metal surfaces.

#### UXO Metal Casing Corrosion Potentials

Using the variables presented in Appendix F as a reference, it is concluded that the Lakeland soils that comprise most of TA C-62 have a high potential for stimulating the corrosion of UXO metal casings. Although no testing was performed on test area soils, there are inherent characteristics of Lakeland soil and local climate that strongly influence corrosion potentials.

The Lakeland soils are likely very strongly acidic (pH 4.0 to 5.0) which tends to promote the corrosion and oxidation weathering of metal surfaces. The TA C-62 sandy soils also likely have a low pH buffering capacity. Buffering capacity is a measure of the ability of the soil to withstand extreme changes in pH. Soils with low buffering capacity are normally subject to dramatic fluctuations in pH levels, which could promote corrosivity.

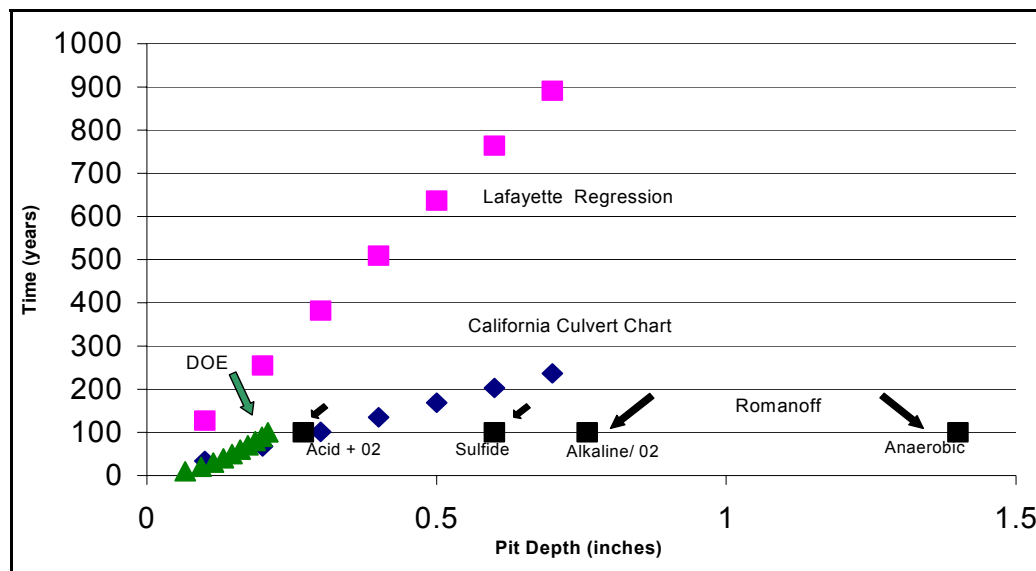
The coarse sand texture of the Lakeland soil ( $\geq 90$  percent quartz sand) facilitates formation of relatively large spaces between soil particles, which promote the oxygenation of the soil profile. The high rainfall (mean annual precipitation of greater than 60 inches per year) and subtropical temperatures that characterize the test area enhance metal degradation rates compared to cooler climates. No soil pH testing or soil resistivity surveys (combination of soil moisture, soluble ion concentration, and soil type) were performed on the test area. Field research data from four sources were compiled by the U.S. Army Environmental Center to illustrate the relationship between soil conditions and the rates of metal pit corrosion (Figure 4-21).

Based on the data presented in Figure 4-21 it could take up to 200 years for pitting corrosion to perforate a metal casing one-half inch thick in the sandy acidic soils of TA C-62. Based on the information presented in the preceding discussion, it is concluded that ordnance metal casing corrosion is likely active in the TA C-62 soil environment; however, the estimated slow rates of the pitting corrosion limit the extent by which UXO metal casing corrosion can be considered a source of explosives contamination. The potential presence of cracked or otherwise damaged UXO materials that were perforated as a result of impact with the ground or other objects is a more likely source of UXO contamination.

#### UXO Explosive Materials Transport Potentials

The chemical and physical attributes of the Lakeland soils also minimize the capacity of the soil environment to immobilize or degrade explosive materials potentially released from munitions casings. Typically, Lakeland soils have a predominantly sand texture ( $>90$  percent), an organic matter content of less than 1 percent, and clay content of less than 2 percent. Organic matter and clay are the soil constituents that primarily determine the soil Cation Exchange Capacity (CEC), which is a measure of the soil's ability to absorb and release cations. The low CEC that characterizes TA C-62 Lakeland soils is an especially important soil parameter with regard to the

fate and transport of explosive residues, since these residues will often replace exchangeable ions such as sodium, potassium, calcium, and magnesium that naturally occur in soil. The ion exchange process immobilizes chemical constituents by electrically binding them with other soil particles, which also makes them susceptible to transformation by soil microbes.



**Figure 4-21. Relationship of Soil Conditions (Acid + O<sub>2</sub>, Sulfide, Alkaline/O<sub>2</sub>, and Anaerobic) to the Rate of Metal Pitting Corrosion**

(Source: U.S. Army Environmental Center, 2001)

The relative infertility of the Lakeland soils also limits the production of plant biomass that is an indispensable component of soil organic matter production. Soil testing of TA B-75 Lakeland soils similar to the soil on TA C-62 found that nitrogen (0.00 to 0.01) was relatively undetected and phosphorus (1.45 to 2.79) and potassium (1.50 to 6.00) levels were limiting factors to plant biomass production (U.S. Air Force, 2000f). Nutrient limitations also reduce the density, diversity, and growth of soil microbes and plants that would support the immobilization of chemical constituents through degradation, complexation, and plant uptake processes. The vegetative cover of the central, southern, and northwestern portions of TA C-62 is severely depleted compared to areas undisturbed by roller drum chopping. The resulting shallow, low-density root systems provide little support for the growth and diversity of essential soil microbes.

### Controlling Metal Corrosion

Controlling UXO metal casing corrosion involves hindering the natural chemical reactions that occur between the metal surface and the environment. While soil corrosivity can exist within a broad range of soil conditions, the extent of soil acidity or alkalinity expressed as pH directly influences metal corrosion susceptibility and rates (Figures 4-21 and 4-22). Corrosion rates increase as the pH decreases (acid gets stronger) (U.S. Environmental Protection Agency, 2001). However, as illustrated in Figure 4-22, beneficial results associated with altering soil pH are not likely to materialize unless the baseline pH is 4 or less. A naturally occurring pH of 4 or less, although not impossible, is an unlikely condition for the Lakeland soils of TA C-62. Soil pH testing is required to determine the pH range of area soils.

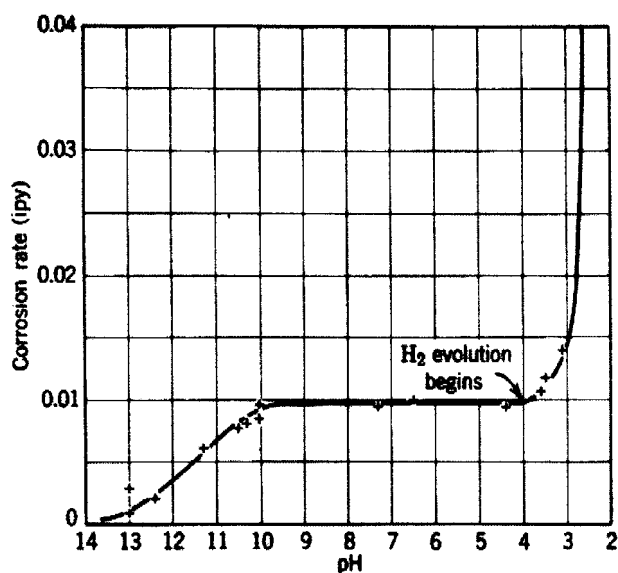


Figure 4-22. Effect of pH on Corrosion Rate

### Surface Water

Having documented the direct connection between groundwater and TA C-62 stream flows and the susceptibility of test area Erosion Impact Areas to transport sediment borne contaminants directly into receiving waterways, it is anticipated that test area streams particularly the western headwater stream segment of Blount Mill Creek experience periodic exposure to explosive materials. There is also the potential for the direct deposition and degradation of ordnance within the stream channel or adjacent wetlands. Subsequent UXO metal casing degradation would deliver explosive materials directly into waterways.

Aside from historic ordnance potentially deposited directly into stream and wetlands during past live ordnance training missions, current CE-EOD OB/OD events are identified as a potential source of direct deposition ordnance. Based on TA C-62 field investigations, there is evidence that some live ordnance may not be demilled during OB/OD operations but deposited great distances from the CE-EOD unit. As previously discussed, UXO deposited in streams or wetlands could undergo aerobic or anaerobic corrosion. Stream sampling data was not available; therefore the presence and fate of explosive contaminants potentially suspended in test area stream flows was not analyzed.

### Biological Resource Impact Potentials

Natural resources personnel have reported at least one instance of a deer ingesting an illumination flare parachute; the deer was attracted to the smoke by-products (i.e. salts) coating the chute and the chute became stuck in the animal's throat. Plastics and other debris are also documented hazards to animals. However, TA C-62 debris was not identified as a hazard of potential consequence to state or federal listed species that may occur on or near the test area.

High densities of surface debris could also occupy sufficient space to suppress the growth of ground cover. The highest densities of munitions debris are primarily within or in close proximity to bombing (TT-1, TT-4, and TT-6) and aircraft gunnery (TT-3) targets. Since air-to-surface bombing targets TT-1, TT-4, and TT-6 and aircraft gunnery target TT-3 are required to be maintained with minimal vegetation cover to assist in target recognition and scoring, no adverse impacts to vegetation associated with high density munitions target debris is anticipated.

There is the potential for munitions debris to be distributed great distance and concentrated in proximity to sensitive habitats such as the Longleaf Pine Sandhill Tier I habitat south of TA C-62 and the seepage slope bog wetland along the western headwater of Blount Mill Creek by CE-EOD OB/OD operations. As has been discussed, OB/OD operations can potentially

distribute high explosive materials over 1,000 feet from the OB/OD unit in the southern section of TA C-62.

Metal corrosion and breakage of post CE-EOD OB/OD mission debris and historic UXO are considered potential sources of explosive materials surface water and groundwater contamination. Since explosive materials have been detected up gradient and down gradient of the CE-EOD OB/OD unit and groundwater flow is directly linked to stream channel flow, there are potential aquatic organism impact pathways associated with TA C-62 streams and wetlands. Particular attention is focused on the western headwater of Blount Mill Creek adjacent to the CE-EOD OB/OD since explosive residues have been detected in groundwater. Aquatic organism impact potentials are directly related to the potential for toxic chemical concentrations.

The toxicity of a chemical is a measure of its ability to harm organisms. Harm may come in the form of interference with biochemical processes, interruption of enzyme function, and/or organ damage. Probably the best-known expression of toxicity is the LD50 and LC50 dose concentration that is lethal to 50 percent of the test population. Aquatic organism ecotoxicological categories and toxicity ranges as defined by the U.S. Environmental Protection Agency (1988) are presented in Table 4-29 and a summary of aquatic species toxicity studies relating to 2,4,6-trinitrotoluene (TNT), 2,4,6-trinitrotoluene (Alpha-TNT)), 2,4-dinitrotoluene (2,4-DNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), nitrocellulose, and nitroglycerin exposures are presented in Table 4-30.

**Table 4-29. Aquatic Organism Ecotoxicological Categories\***

Category	Concentration (mg/L)**
Very highly toxic	<0.1
Highly toxic	0.1-1
Moderately toxic	>1-10
Slightly toxic	>10-100
Practically non-toxic	>100

\* The higher the number the lower the acute toxicity.

\*\* Concentration in water is unrelated to body weight of test animal.

TNT of explosive grade is highly toxic to marine forms including freshwater green algae (*Selenastrum capricornutum*), tide pool copepods (*Tigriopus californicus*), and oyster larvae (*Crassostrea gigas*), and mutagenic to *Salmonella typhimurium*. In contrast, the major microbial metabolites of TNT appear to be nontoxic and nonmutagenic to aquatic organisms (Won et al., 1976).

Some pollutants interact with solar near ultraviolet light in a manner that greatly increases their toxic effects. A study by Davenport et al., (1994) investigated light mediated toxicity of TNT, reduction transformation products 2,3-, 2,4-, 2,6-, and 3,4-DNT and diaminotoluene (DAT) and major metabolites 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene to *Daphnia magna* (daphnia) and *Lytechinus variagatus* (sea urchin). Most of the compounds were weakly toxic or nontoxic in the dark. All compounds were phototoxic to sea urchins. In daphnia, 2,3 and 3,4-DAT/DNT and 4 A were not toxic but were phototoxic; the other compounds were not toxic or phototoxic to daphnia.

Table 4-30. Explosive Materials Aquatic Species Toxicity Studies

Study	Constituent(s)	Aquatic Species	Results/Criteria	Reference*
Acute Toxicity	TNT	Aquatic fish and invertebrates	Studies indicate LC <sub>50</sub> toxicity values ranging from 5.2 to 27.0 mg/L for invertebrates in 48 hour test and 2.0 to 3.7 mg/L for fish in 96 hour tests.	Ryon, 1987
		Bluegills	Ninety six hour LC50 values ranged from 2.3 to 2.8 mg/L.	Pederson, 1970
	2,4-DNT	Juvenile bluegills	Growth rates decreased with increasing 2,4-DNT concentration. The threshold concentration for significant growth reduction was 0.05 mg/L. The 2,4-DNT was rapidly absorbed, reached relatively low bioconcentration levels, and was rapidly eliminated when fish were placed in 2,4-DINT free environment.	Hartley, 1981
		NA	DNT appears to be somewhat less toxic to fish than TNT and relatively nontoxic to microorganisms.	Jaffe et al., 1973
	RDX	Fathead minnows	Acute LC <sub>50</sub> values are greater than 3 mg/L. Lack of bioaccumulation in edible or nonedible tissues or organs in all species tested. Effects on growth of eggs and fry at 5.8 mg/L and on survival at 4.8 mg/L. Proposed RDX water quality criterion is 0.35 mg/L.	Bentley et al., 1977
	HMX	Algae species, fathead minnow	No adverse effects of exposure to 32 mg/L observed among algae species. Seven-day old fathead minnow only life stage or species acutely affected. Proposed freshwater aquatic water quality criterion of 0.75 mg/L.	
	Nitrocellulose	Species of several different aquatic trophic levels	No acute toxic effects observed among fish, invertebrate, or algal species tested with the exception of <i>Selenastrum capricornutum</i> . No adverse effects were observed among chironomid populations exposed to 540 mg nitrocellulose/kg of sediment over two generations.	Bentley et al., 1976
Chronic Toxicity	TNT	Fathead minnows and <i>Daphnia magna</i>	A concentration of 0.9 mg/L should not be exceeded over a 24-hour period. A concentration of 0.04 mg/L should be used as an interim 24 hour average allowable concentration until a chronic no effect level is experimentally defined for fathead minnows exposed to TNT.	Bailey et al., 1985
Acute and Chronic Toxicity	RDX	Fathead minnow	Acute 96 hour LC <sub>50</sub> for 15 to 17 day old minnows was 12.7 mg/L. The lowest observed-effect concentration and the no-observed-effect concentration was 2.4 and 1.4 mg/L respectively.	Burton and Peters, 1994
		Daphnid ( <i>Ceriodaphnia dubia</i> ), hydra ( <i>Hydra littoralis</i> ), and midge ( <i>Paratanytarsus partenogeneticus</i> )	RDX at concentrations of 17.0 mg/L (daphnid), 32.3 mg/L (hydra), and 29.2 mg/L (midge) were not acutely toxic. The no-observed effect concentration, lowest observed-effect concentration, and chronic value for daphnid were 3.64, 6.01, and 4.68 mg/L, respectively. Although not statistically significant, reductions in emergence success were observed in midges at concentrations as low as 6.78 mg/L.	Peters et al., 1994
		Review of aquatic organism studies	Recommends aquatic environmental water quality criteria of 0.30 mg/L (24 hour average).	Sullivan et al., 1979
	Nitroglycerin		Recommends aquatic environmental water quality criteria of 0.01 mg/L (24 hour average).	

\*Source: U.S Army Corps of Engineers, 1998



A comparison of CE-EOD OB/OD unit September 1996 through November 1999 averaged groundwater monitoring well data for RDX, HMX, and nitroglycerin concentrations and aquatic environment water quality criteria from a review of the literature (Table 4-30) are presented in Table 4-31.

**Table 4-31. CE-EOD OB/OD Unit Groundwater Monitoring Data for RDX, HMX, and Nitroglycerin Averaged Over a 14 Quarter Period**

CE-EOD Groundwater Monitoring Data			Criteria	
Constituent	Groundwater Monitoring Well	Averaged Groundwater Concentration (mg/L)	Criteria Derived From the Literature (mg/L)	Toxicity Category
RDX	MW94-62-1, -2, -3, -4, and -5	0.0014	0.30	Highly Toxic
HMX	MW94-62-4 and -5	0.0017	0.75	
Nitroglycerin	MW94-62-1, -2, -3, -4, and -5	0.0017	0.01	Very Highly Toxic

Based on a review of the literature and TAC-62 CE-EOD OB/OD unit groundwater monitoring well data, no impacts to Blount Mill Creek aquatic organisms are anticipated; RDX, HMX, and nitroglycerin concentrations are well below the criteria presented in Table 4-31. It is important that soil reactive TNT is highly toxic to aquatic species, but its metabolites including 2,4 and 2,6-DNT and 2 and 4-amino-2,6-DNT appear to be nontoxic and nonmutagenic to aquatic organisms in the absence of light. However studies have shown that there is the potential for aquatic species phototoxicity associated with exposure of TNT metabolites to sunlight. The potential for changes in toxicity associated with movement of explosive contaminants from groundwater regimes to wetlands and streams exposed to light could not be quantified. No TA C-62 stream or wetland water sampling data was available.

### Alternative 1 and 2 Chemical Materials and Debris Summary

The area of concern that was the focus of this analysis was the CE-EOD OB/OD area in the southern portion of the test area. The area was used in the past (1940s through 1960s) for live bomb training and is current used as an explosive ordnance area. Up gradient and down gradient groundwater monitoring well exceedences of water sampling criteria were identified for explosive residues including nitroglycerin, and the TNT metabolites 2,4-DNT and 4-amino-2,6-DNT. Sources of explosive contaminants include open detonation and open burn operation residues and the corrosion and release of explosive materials from the metal casings of UXO and live ordnance item that survive CE-EOD OB/OD mission events.

The western headwater of Blount Mill Creek and associated sensitive seepage slope bog wetland are directly linked to explosive contaminants suspended in groundwater. The presence of a seepage slope bog signifies the likely presence of a perched water table or other aquitard, which could minimize vertical and accelerated lateral migration of groundwater contaminants toward receiving surface waters. The sensitive seepage slope bog includes state listed plant species and Blount Mill Creek flows through a Longleaf Pine Sandhill Tier I habitat south of the test area. Chemical material and debris issues of concern identified by this analysis include:

- *Direct exposure of CE-EOD open detonation event explosive residues to groundwater:* The open detonation pit on the western portion of the CE-EOD OB/OD unit has evolved into a crater with at least two feet of exposed water table at the bottom of the pit. Particulate matter and other debris generated by OB/OD missions are susceptible to direct deposition into exposed groundwater or transport into the bottom of the pit by erosion.
- *Impact perforated metal casings of UXO originating from historic target TT-1 bombing operations are susceptible to the release of explosives into soil or water environments:* The impact of historic air-to-surface ordnance with the ground or other objects before coming to rest on the surface or buried underground may have resulted in cracks or breaks in the metal casings. Once perforated, previously contained explosive chemicals are susceptible to leaching into soil and groundwater or transported to receiving waters by stormwater runoff. Although the soil environment and climate that characterize TA C-62 facilitate nearly year round corrosion and pitting of metal surfaces, the estimated slow rate of UXO pitting corrosion (~0.0025 inches per year) limits ordnance metal casing corrosion as a source of explosives contamination.
- *TNT reduction transformation products and metabolites detected in groundwater could become phototoxic to some aquatic species following exposure to sunlight:* Exposure of TNT by-products to solar near ultraviolet light could greatly increase their toxic effects. Compounds identified as nontoxic or weakly toxic in groundwater could become phototoxic once exposed to light in wetlands or stream channels.

#### 4.5.2 Alternative 3

The proposed Alternative 3 TA C-62 Contaminant Management BMPs are presented in Table 4-32, discussed in the following section, and described in detail in Appendix A.

**Table 4-32. Alternative 3 Range Sustainability Contaminant Management BMPs**

Management Category	Environmental Sensitivity Assessment			Recommended BMPs	
	Issues	Document References	Application Area(s)	Practices	Appendix A Reference
<b>Contaminant Management</b>	High density of surface UXO and documented ground-water explosive residue contamination	UXO	All test areas lands for UXO and CE-EOD OB/OD site for groundwater contamination	Stream Slope Restoration	A-2
		Appendix A		Surface UXO and Debris Recovery	A-28
		IRP/AOC		CE-EOD OB/OD Unit	A-29
		Appendix A		Soil Disturbance Management	
		Figure 3-25		Phytoremediation	A-30
		Phytoremediation		Groundwater Stabilization/Treatment System	
		Figure A-4			

The proposed TA C-62 Alternative 3 Contaminant Management BMPs include:

- *Stream Slope Restoration:* The proposed restoration of the EIA-1 stream slope would restore the soil quality, soil binding, and material filtering capability of vegetative cover. The populations, diversity, and viability of soil microbial communities that are a critical component of energetic materials biodegradation would also improve with the addition of vegetation on the presently denuded site.

- *CE-EOD OB/OD Area Surface UXO and Debris Recovery:* The proposed recovery of UXO and debris from the CE-EOD OB/OD area would reduce a potential safety risk and source of explosive material contamination. The use of the Transportable Burn Kettle Processor (TBKP) technology to replace current unconfined kettle open burns would substantially reduce shrapnel and debris and minimize potential air emissions.
- *CE-EOD Open Detonation Unit Soil Disturbance Management:* The filling-in of the two existing pits, termination of blast pit construction for open detonation events, and rotation of open detonation sites within the 200 × 400 foot construction would reduce groundwater exposure potentials.
- *Phytoremediation Groundwater Stabilization/Treatment System:* Installation of an in-situ phytoremediation system within EIA-1 down gradient of the seepage slope bog wetland would assist in stabilizing surface soils and provide a self-sustaining, natural method of immobilizing and degrading OB/OD surface and groundwater munitions residues.

Other proposed Alternative 3 BMPs that also contribute to minimizing chemical material impact potentials include:

- *Open Detonation NEW Limit:* The Alternative 3 Noise Management CE-EOD open detonation 1,000 lb NEW BMP would reduce the extent of potential chemical materials contamination. The 1,000 lb NEW CE-EOD explosive package limitation would increase the number of detonation event for a 5,000 lb ADR mission event from two 2,500 lb NEW detonations (Alternative 2) to five 1,000 lb NEW detonations.
- *Wetland Management:* Implementation of the Alternative 3 Wetland Management Boundary Markers and Prescribed Burning BMPs would increase the protection and conservation of the seepage slope bog wetland along the headwater of Blount Mill Creek. The maintenance of this wetland ecosystem provides a natural filtering system for treating surface water runoff and groundwater seepage flows.
- *Integrated Vegetation Management System:* The Alternative 3 Grassland/Shrubland Vegetation Management elimination of roller drum chopping vegetation controls and implementation of an herbicide and controlled burn management system would reduce the potential for transport of materials by sediment into receiving streams. Properly implemented, there are no adverse impacts to biological systems.

Implementation of these proposed BMPs would reduce potential chemical material and debris mission impacts on terrestrial, wetland, and aquatic resources; contribute to maximizing the mission sustainability of the test area; and increase the water quality and habitat values of the area by providing mechanisms for removing, reducing, immobilizing, and treating chemical material by-products and debris.

### **CE-EOD Open Detonation Chemical Material Impact Potentials**

In the sections that follow, an estimate of the air and soil chemical materials concentrations generated by a 1,000 lb NEW open detonation (Alternative 3 Noise Management BMP) of TA C-62 CE-EOD baseline expenditures are calculated and the correlation of EIA-1 restoration and biodegradation of energetic materials by-products of concern are discussed.

**Potential Impact Scenario**

The potential components of a 1,000 lb NEW mission event explosive package used for this analysis are presented in Table 4-33 and an estimate of by-products and potential exposure concentrations are presented in Table 4-34.

**Table 4-33. Simulated Alternative 3 CE-EOD 1,000 lb NEW Explosive Package Components**

Ordnance	Unit Quantity	Total Explosive Material (Net Explosive Weight in Pounds)		Quantity of Lead Compounds (lbs)
		Propellant	RDX Explosive	
M-30 Propellant	300 Pounds	300	0	0.00004/pound
20 mm HEI	1,745 Rounds	150	50	0.0003/round
40-mm HEI	100 Rounds	115	87	0.0001/round
7.62-mm Ball	14,926 Rounds	100	0	0.00003/round
HBX Explosive	100 Pounds	0	100	0.0001/pound
BBU-36/B Impulse Cartridge	22,728 Cartridges	0	50	0
C-4	48 Pounds	0	48	0

Source: Midas Database

The estimated peak concentrations of CO were substantially less than NAAQS standards. Based on the mission event impact scenario, there is the potential for nitrogen dioxide (NO<sub>2</sub>) and lead emissions to exceed NAAQS air quality standards. Within the parameters of the soil quality scenarios, the detonation of five 1,000 lb NEW explosive packages comprised of the components listed in Table 4-33 is estimated to generate a soil lead concentration of 0.2 mg/kg. This concentration is substantially less than the U.S. Environmental Protection Agency Region III Risk-Based Criteria of 400 mg/kg and the 39.64 mg/kg background lead concentration for Eglin's surface soils.

**Table 4-34. Estimated Peak Concentration of Air Emissions Generated by the Detonation of a 1,000 lb NEW Explosive Package**

Ordnance Materials	Criteria Pollutant								
	Emission Factor			Total Emission By-product/Explosive Package Detonation					
				Total Emission (grams)			Exposure Cone Peak Concentration and NAAQS Standards		
	CO (lb/lb)	NO <sub>2</sub> (lb/lb)	Lead (lbs)	CO	NO <sub>2</sub>	Lead	CO 40 mg/m <sup>3</sup>	NO <sub>2</sub> 100 µg/m <sup>3</sup>	Lead 1.5 µg/m <sup>3</sup>
M-30	0.0015	0.00010	0.014	204	14	5	0.2	12	5
20 mm	0.1100	0.00047	0.524	907	43	238	9.0	39	218
40-mm	0.0210	0.00047	0.010	191	43	5	0.2	40	4
7.62-mm	0.00025	0.00047	0.003	11	21	1	0.0	19	1
HBX	0.0052	0.00004	0.035	236	2	5	0.2	2	4
BBU-36/B	0.0084	0.00061	0.000	191	14	0	0.2	13	0
C-4	0.2300	0.00024	0.000	5,008	5	0	5	5	0
<b>Explosive Package Emission By-product</b>				<b>6,748</b>	<b>142</b>	<b>254</b>	<b>15</b>	<b>130</b>	<b>232</b>

It is concluded that the airborne lead emission estimates for mission events on TA C-62 are within timeframe tolerances for single event expenditures and that the actual measured post-event concentration will vary dramatically based on mission and climatic variables. There

is the potential for open detonation by-products to impact the surface waters of the western stream headwaters segment of Blount Mill Creek.

### ***Immobilization and Treatment of CE-EOD OB/OD Energetic Material Residues***

Although munitions chemical by-products often naturally biodegrade, the rate of degradation and retardation is normally not sufficient to prevent continued migration into uncontaminated areas resulting in ongoing environmental concerns. Groundwater monitoring of the CE-EOD OB/OD unit detected nitroglycerin, 2,4-dinitrotoluene, and 4-amino-2,6-dinitrotoluene at concentrations that exceeded permit standards and/or limits. These water soluble compounds and other chemical by-products are susceptible to migration into the water table because of the quartz sand texture, low percentage of organic matter, high infiltration rates, and very high permeability that characterize the Lakeland soils. Once in the water table, suspended contaminants migrate towards the headwater of Blount Mill Creek to the west of the CE-EOD unit. The potential presence of a perched water table (section 3.2.3) could reduce vertical water migration and increase lateral groundwater flows. Contaminant residence times within the vadose zone could also be decreased substantially.

Alternative 3 proposes to use the naturally engineered attributes of self-sustaining ecosystems to manage surface and groundwater munitions chemical materials exposures generated by CE-EOD operations and potential residue contributions of historic subsurface UXO. Proposed CE-EOD OB/OD munitions residue treatment mechanisms discussed in the following narrative include stream slope restoration attenuated soil biodegradation, wetland management water quality functions, phytoremediation groundwater stabilization/treatment system, and CE-EOD Open Detonation unit soil disturbance management.

#### ***Stream Slope Restoration Attenuated Soil Biodegradation***

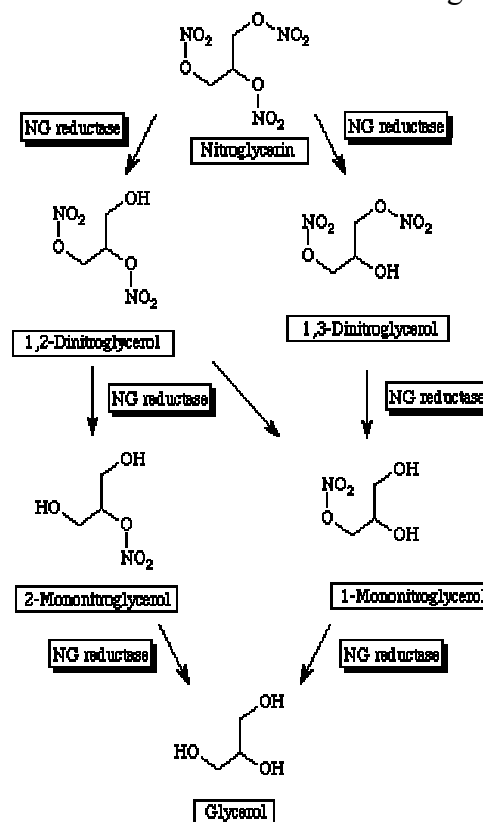
Other than incineration, biodegradation is the only mechanism for transforming toxic compounds into harmless water, carbon dioxide, and/or methane (U.S. Army Corps of Engineers, 1999). Soil and groundwater microbiota are recognized as a primary influence on the fate and transport of organic contaminants and heavy metals (Boulding, 1994). As chemical materials leach through the soil subsurface and vadose zone soil, microorganisms interact and, in some instances, degrade contaminants. Soil and groundwater microbes can completely break down some explosive by-products to carbon dioxide, water, and/or methane. For biodegradation to occur, existing microbial populations must contain the gene coding for the appropriate enzymes and those genes must be expressed. Microbial adaptations are most evident in soils that have received repeated applications of explosive residues.

Soil biodegradation is most likely to occur within the region of influence of the plant root rhizosphere during translocation by soil water and plant uptake. The extent of compound degradation by soil microbes may further depend on the type of plant roots – woody and/or herbaceous plants – and the density and depth of the root system. The type, density, and depth of plant root systems have a direct bearing on soil microbial activities. Degradation rates tend to decline with increasing depth below the root zone and constituent degradation within aquifer materials may be very slow or non-existent (Anderson and Coats, 1994; Darrah, 1993; Walton and Anderson, 1990; Anderson et al., 1990).

Explosive compounds tend to be resistant to degradation under aerobic conditions but are readily transformed by microorganisms under anaerobic conditions. However, compound degradation pathways are frequently influenced by aerobic organisms. The environmental and physiological factors and biodegradation pathways of energetic materials are not well understood (U.S. Army CERL, 1999). In the section that follows, the potential biodegradation of nitroglycerin, 2,4-dinitrotoluene and 4-amino-2,6-dinitrotoluene is discussed.

A study by Chritodoulatos et al. (1997) showed that soil and groundwater bacteria species *Pseudomonas Putida* II-B and *Pseudomonas fluorescens* I-C are capable of utilizing nitroglycerin as a sole source of nitrogen under anaerobic conditions. These bacteria initiate the denitration of nitroglycerine, but other microbes likely contribute to its mineralization along the pathway (Figure 4-23a). Generally, aerobic mineralization is only detected with bacterial organisms (*Pseudomonas* spp., *Rhodococcus erythropolis*, and *Mycobacterium* spp.).

The U.S. Environmental Protection Agency has listed 2,4,6-trinitrotoluene (TNT) as a priority pollutant and recommended its removal from contaminated sites. TNT is toxic to algae and invertebrates, and based on animal studies USEPA has determined that TNT is a possible human carcinogen. Aerobic and anaerobic biodegradation pathways for TNT are shown in Figures 4-23a, 4-23b, and 4-24. Microbial transformation of TNT normally begins with reduction of one of the nitro groups. Aerobic bacteria are able to reduce two of the three nitro groups of TNT; reduction of the third nitro group requires anaerobic conditions. Bacterial denitration of TNT or its reduction products has been demonstrated for 2-amino-4-nitro-toluene produced from 2-amino-4,6-dinitrotoluene and 2,4-dinitrotoluene produced from TNT. TNT biodegrading bacterial strains include *P. savastanoi*, *Rhodococcus erythropolis*, and *Mycobacterium* sp.



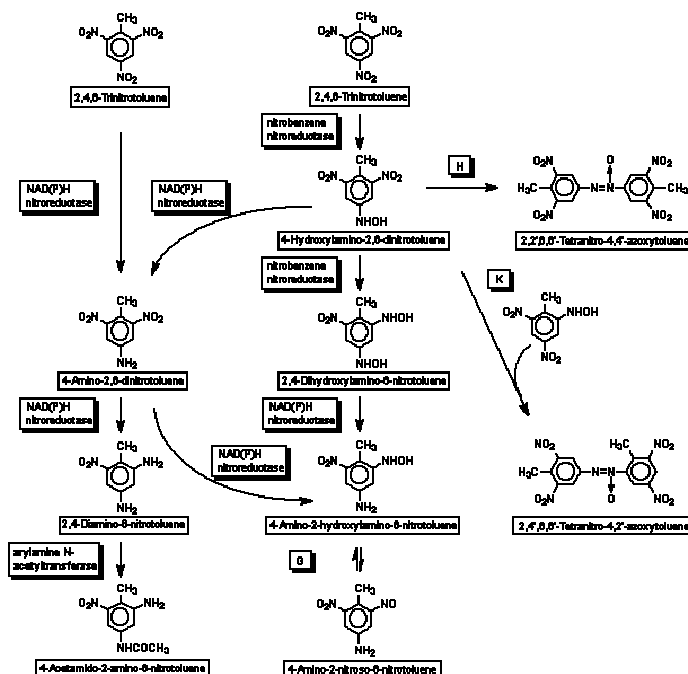
4-23a. Nitroglycerin Pathway

2,4-Dinitrotoluene and 4-amino-2,6-dinitrotoluene detected in the open detonation unit down gradient groundwater monitoring wells are potentially the result of anaerobic bacterial denitration of TNT. 2,4-Dinitrotoluene and 4-amino-2,6-dinitrotoluene are considered resistant to biodegradation under unacclimated aerobic conditions, strongly susceptible to volatilization from water, soil, or surfaces, and strongly adsorbed to soil and sediment. The last reduction steps to produce triaminotoluene occur only under anaerobic conditions; enzymes that catalyze these reactions are found in *Desulfovibrio* sp., *Clostridium pasteurianum*, and *Moorella thermoacetica* (Howard et al., 1991).

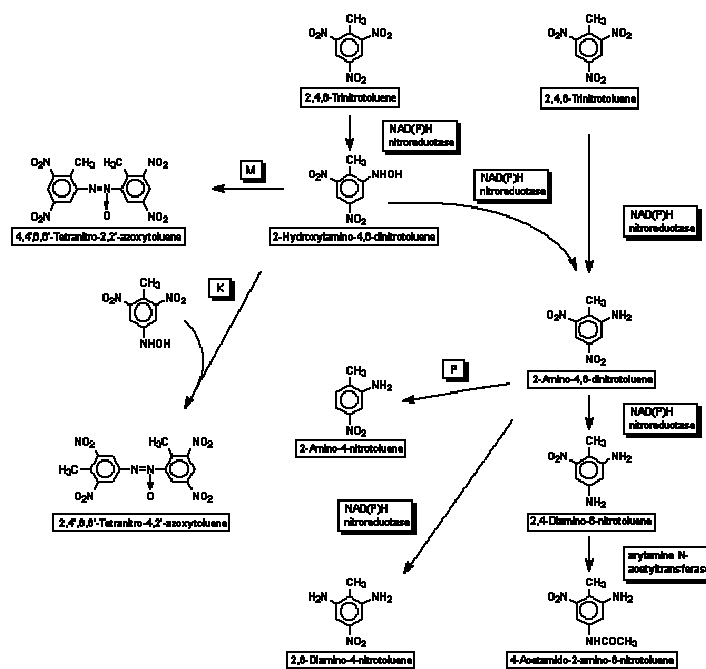
The TNT biodegradation by-products discussed above are highly reactive and tend to covalently bind to cellular components and solids including organic and soil colloids. However, the Lakeland soils of the area are generally characterized as having low organic matter levels of less than one percent and extremely low cation exchange capacity (<4 meq/100g), which reduces the capacity of the soil to interact and bind 2,4-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and other TNT by-products. The naturally high leaching potential of the Lakeland soils is further exacerbated by the severely eroded and denuded condition of EIA-1.

The restoration of Erosion Impact Area (EIA)-1 stream slopes to native grasslands as described in Appendix A would introduce root systems to the denuded surface and transform the “biological desert” soil condition of EIA-1 to a stable landscape with capabilities for supporting vegetation and a diversity of microbial populations.

The proposed addition of mature compost (Appendix A, section 1.2.2) during EIA-1 stream slope soil reconditioning would enhance microbial populations, which would increase soil fertility and water holding capacity required for vigorous plant growth and development. Mature compost has high microbial diversity with microbe populations much higher than fertile productive soil and substantially higher than disturbed or contaminated soil (Table 4-33). Based on the extent of soil loss, exposure of naturally infertile geologic layers, and little or no soil organic matter, it is estimated the microbial populations for EIA-1 are well below the ranges presented in Table 4-35.



4-23b. Trinitrotoluene Pathway 1 Aerobic



4-23c. Trinitrotoluene Pathway 2 Aerobic

Figure 4-23. Nitroglycerin and TNT Biodegradation Pathways

Research indicates that compost can reduce toxicity of contaminated soil primarily through the adsorption of compounds to the organic matter in compost and stimulation of contaminant biodegradation as microorganisms use contaminants as a food source (U.S. Environmental Protection Agency, 1997 and 1998a). Reintroduction of microbial diversity and populations associated with composting could enhance contaminant biodegradation potentials and the capabilities of the soil to support vegetation and reduce soil erosion potentials.

It is concluded that the Alternative 3 proposal for the restoration of EIA-1 stream slopes to native vegetation could reduce the loss of soil and energetic materials to erosion, improve the capability of the damaged soil matrix to biodegrade explosives residues, and with the reintroduction of root systems, increase the complexation and immobilization of energetic wastes.

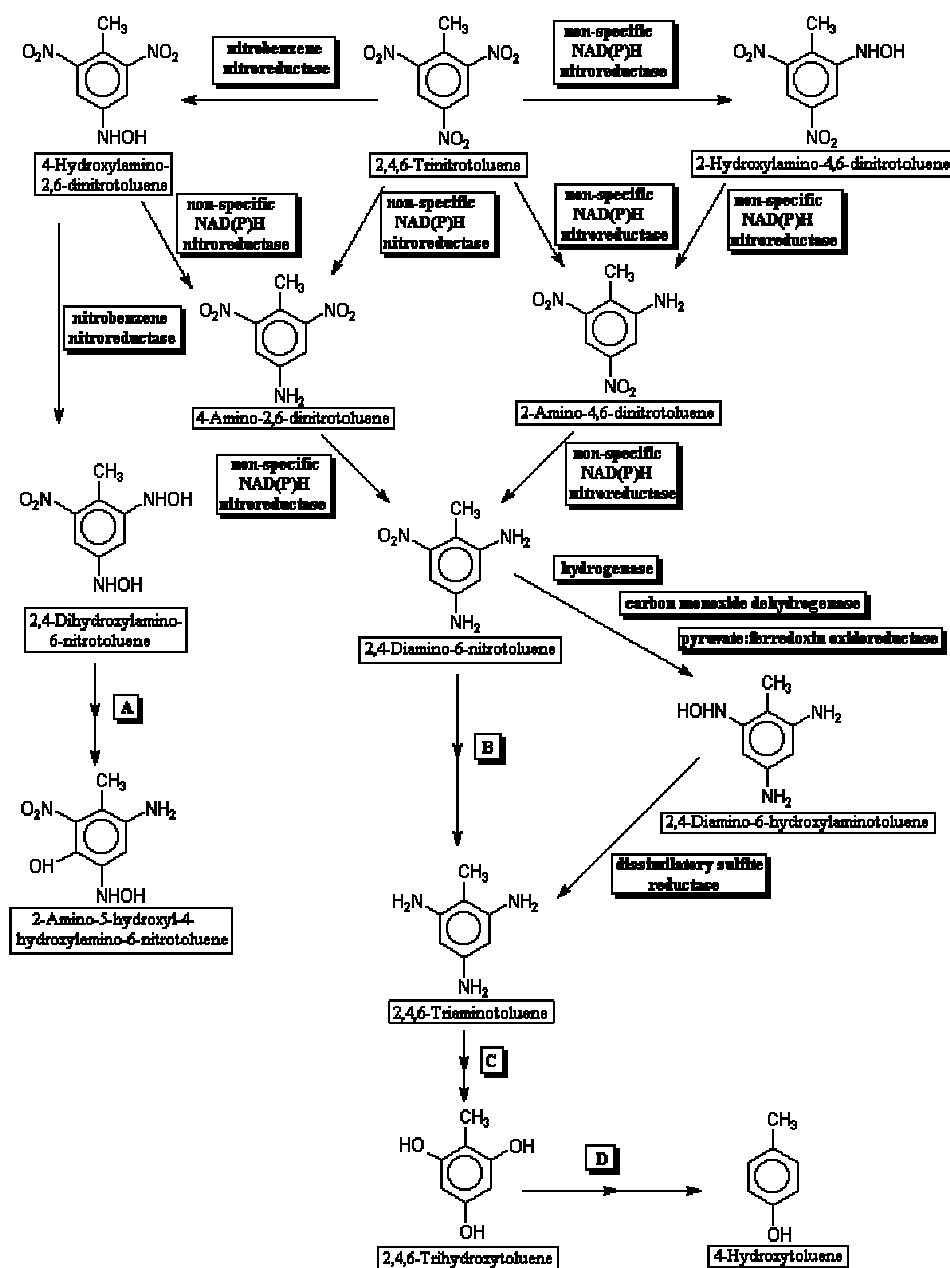


Figure 4-24. Trinitrotoluene Pathway Anaerobic



**Table 4-35. Microbial Populations in Soil and Mature Yard Trimmings Compost**

<b>Materials</b>	<b>Microbe Populations</b>	
	<b>Bacteria</b> (millions per gram dry weight)	<b>Fungi</b> (thousands per gram dry weight)
Fertile Soil	6 to 46	9 to 46
Recently Reclaimed Soil After Surface Mining	19 to 170	8 to 97
Pesticide-Contaminated Mix of Silt and Clay	19	6
Mature Compost	417	155

Source: U.S. Environmental Protection Agency, 1998a

*Wetland Management Enhanced Water Quality Functions*

The beneficial water quality functions of freshwater wetlands are well documented (Clark and Benforado, 1981; Wharton, 1982; Adamus and Stockwell, 1983; Smith, 1984; Wilkinson and Schneller-MacDonald, 1987; Gosselink and Lee, 1987; Richardson, 1989). Because of their transitional position on the landscape, wetlands tend to be collectors and manipulators of inputs and have a unique tolerance and capacity to assimilate, transform, store, and cycle organic and inorganic inputs. Kadlec and Kadlec (1978) suggested that every water quality parameter can be altered by passage through a wetland. The characteristics of wetlands that contribute to altering the condition and concentration of inputs includes high plant productivity and diversity, high decomposition rates, large adsorptive areas, and high redox potentials. The impact of additional inputs on wetland is generally less than on terrestrial and aquatic communities because wetland plants are adapted to anaerobic conditions (Bastian and Benforado, 1988).

The stream riparian and seepage slope bog wetlands associated with EIA-1 at the headwaters of Blount Mill Creek, although not to be considered a waste treatment system, provide natural treatment capabilities that could reduce the transport and concentration of chemical materials in surface and groundwater, which could benefit overall water quality. The perched water table that potentially underlies the CE EOD open detonation unit could put explosive residues in direct contact with the seepage slope bog on the eastern portion of the creek. Explosive residue immobilization and transformation water quality treatment capabilities of the seepage slope bog are generally dependent on water input residence time within the wetland, presence of an organic soil substrate, and type and density of vegetation. Additional investigations would be required to estimate specific explosive residue water quality treatment capabilities of TA C-62 wetlands.

The key to maximizing these wetland water quality functions is the maintenance of native vegetation and the required wetland hydrology. The maintenance of Blount Mill Creek western headwater segment wetland vegetation and hydrology is best achieved by:

1. Limiting the extent of suspended solid and chemical material inputs through stream slope restoration and abandoned stream crossing removal and surface disturbances by installing wetland boundary markers to reduce foot and vehicle trafficking
2. Enhancing wetland vegetation diversity by implementing a wetland prescribed burning program.

Wetlands have been used successfully in treating nutrients, metals, and organic contaminants for many years (Schnoor, 1997). Research has shown that many explosive by-products once

released from the soil and dissolved in water can be transformed chemically into less toxic metabolites and assimilated by aquatic plants. As an example, the reduction of TNT nitro groups into a series of aminonitrotoluenes normally takes just a few hours. Researchers have suggested that the breakdown of TNT does not appear to occur in soils and sediments at rates of any significance but instead occur in the plant. Aminonitrotoluenes that leaked into the surrounding water were taken back up into the plant and assimilated (Saunders et al., 1996). The U.S. Army has been instrumental in the development of constructed wetland technologies to remediate groundwater contaminated with explosives such as TNT, hexahydro-1,3,5-triazine (RDX), 2,4,6-trinitrobenzene (TNB), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and associated metabolic by-products.

Lagoon and gravel-bed wetlands were constructed at Milan Army Ammunition Plant near Milan, Tennessee, to treat explosives contaminated groundwater. This study evaluated the relative ability of ten wetland species to decrease levels of TNT and RDX explosives and related contaminants in groundwater. Over a six month period wetland treated concentrations of TNT and TNB were reduced from 4.6 mg/L and 0.35 mg/L respectively to less than 0.002 mg/L. Greater than 90 percent of TNT and RDX contaminants were removed from influent by wetland plants. TNT was identified as most toxic to plants and RDX is normally the least toxic (Best et al., 1998). Similar findings of explosive residue uptake, accumulation, and biotransformation by wetland plants were documented during constructed wetland groundwater treatment studies at the Volunteer Army Ammunition Plant in Chattanooga, Tennessee (Miller et al., 1997).

Based on the documented capabilities of wetland plants to treat groundwater contaminated with explosives, the protection and maintenance of the Blount Mill Creek headwater seepage slope bog wetland (Appendix A: Wetland Management) and enhancement of its water quality treatment capabilities could reduce on- and off-site water quality impact potentials associated with explosive residues.

#### *Phytoremediation Groundwater Stabilization/Treatment System*

The proposed enhancement of soil biodegradation and wetland water quality functions associated with EIA-1 stream slope restoration and Blount Mill Creek seepage slope bog wetland management practices maximize the capabilities of the native terrestrial and wetland environments to absorb and recover from CE-EOD mission events while minimizing environmental impact potentials. However there is still the potential for the groundwater migration of explosive residues into the headwater stream channel of Blount Mill Creek.

Since the potential distribution of explosive residues in EIA-1 soil and groundwater is likely extremely heterogeneous with detect and non-detect-spots in close proximity and at relatively shallow depths (less than 15 feet) associated with a perched water table, a groundwater phytoremediation system becomes a practical long-term treatment option. Phytoremediation is the use of plants and their associated rhizospheric (plant and soil microorganism interface zone around the root) microorganisms to provide *in-situ* stabilization, extraction, degradation, volatilization, and filtration of organic and inorganic chemical constituents in soil and water.

Since plants also reduce erosional transport of contaminated soil when compared to unvegetated material, phytoremediation provides a simple, straightforward approach to the degradation and immobilization of contaminated soil and water. Depending on the contaminant, degradation may

occur within the rhizosphere or plant itself and if the compound is not degraded it will likely volatilize. Regardless of the ultimate fate of the contaminant, once contact with the plant occurs, the water is no longer contaminated.

Plant based remediation is a biological, aesthetically pleasing, solar-energy driven, passive, pump-and-treat technique that can be used to clean up sites with shallow, low to moderate levels of contamination. Some plants have demonstrated unique capabilities to:

- Absorb soil and groundwater xenobiotic constituents.
- Uptake and biotransform toxic contaminants to less toxic or nontoxic metabolites and immobilize them by sequestration into vacuoles or incorporation into cell walls.
- Stimulate the biodegradation of chemicals at plant root rhizospheres by increasing soil microbial activity as roots provide oxygen and organic carbon in the form of exudates; rhizobial and mycorrhizal communities are established in which the metabolic activities of bacteria, fungi, microfauna and plants form complementary systems capable of detoxifying and mineralizing xenobiotic contaminants.
- Enzymes from plant tissues can precipitate and bind aromatic pollutants and degrade organic compounds.
- Tolerate high concentrations of compounds without toxic effects.
- Promote upward movement of groundwater by root uptake and evapotranspiration counteracting the downward migration of contaminants towards groundwater.

Plants have been used to treat petroleum hydrocarbons, chlorinated solvents, pesticides, metals, radionuclides, explosives, and excess nutrients (Schnoor, 1997; Muller et al., 1995).

The potential for contaminant degradation is enhanced by the unique associations developed between plants and microorganisms. As an example, some plants and microbes have demonstrated the capacity to interact in a manner that results in contaminant degradation. Plants roots provide a carbon substrate and nutrients and in return microbial communities associated with the plant root zone (rhizosphere) are stimulated in the course of metabolic activities to degrade contaminants (Siciliano and Germida, 1998).

Processes affecting groundwater transport of explosives include but are not limited to advection, hydrodynamic dispersion, biodegradation, abiotic transformations, sorption, and diffusion, with sorption and transformations being two of the most important processes affecting the fate and transport of explosives (McGarth, 1995). Understanding of fate and transport processes for 2,4,6-trinitrotoluene (TNT) is limited and an understanding of these processes for other explosives such as hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) are even less understood (Brannon, 1997). TNT has been identified as an organic contaminant that sorbs strongly to roots and organic matter, is not translocated to any appreciable degree, and is readily biodegraded (Schnoor, 1997). In some circumstances, TNT sorption to organic matter is irreversible (Brannon and Myers, 1997).

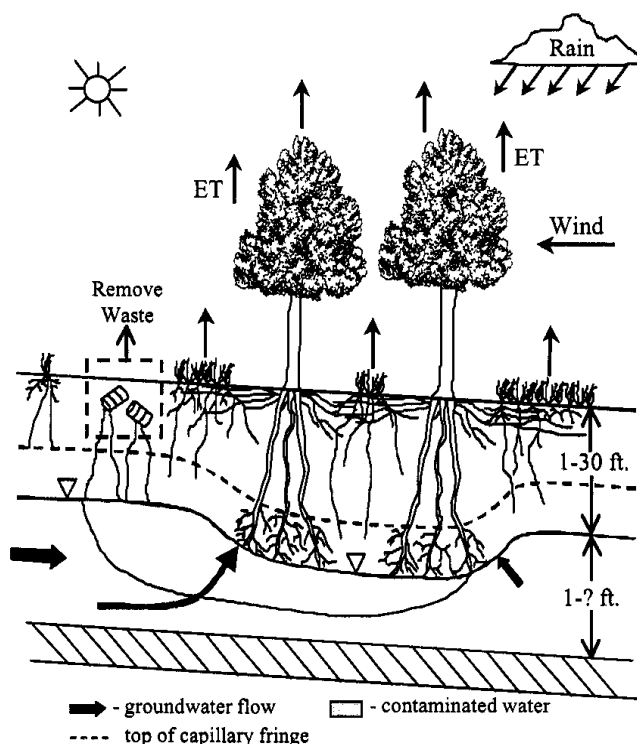
Based on the detection of explosive residues in CE-EOD OB/OD unit background and down gradient groundwater monitoring wells at concentrations above thresholds, subsurface contamination heterogeneity, and site geohydrogeology a phytostabilization system is the

suggested groundwater treatment option for the site. The purpose is to introduce a long-term means of exercising contaminant hydraulic control, stimulate microbial biodegradation, and enhance plant uptake, degradation, and volatilization. Phytostabilization is the use of plants as pump-and-treat mechanisms for capturing and immobilizing and in some cases transforming soil and/or groundwater contaminants through:

- Absorption and accumulation by roots
- Adsorption onto the surface of roots
- Precipitation of chemicals within the root zone (rhizosphere)
- Transformation within the plant and/or biodegradation at the root rhizosphere

Phytostabilization and treatment occurs through plant uptake and evapotranspiration of groundwater, root zone microbiology and chemistry, and/or alteration of the soil environment or contaminant chemistry. Specific plants are used to remove groundwater at a rate sufficient to stabilize down gradient movement of near-surface groundwater (U.S. Environmental Protection Agency, 2000).

The system mechanics primarily rely on the rapid growth and high evapotranspiration of phreatophytes and stimulation of microbial degradation by release of exudates and enzymes into the rhizosphere. For the purposes of this proposal, phytostabilization is based on the use of phreatophytes to remove groundwater at a rate sufficient to stabilize the movement of near-surface groundwater. Phreatophytes are water-loving plants such as willows, cottonwoods, and poplars whose root systems generally extend downwards to the water table and draw water from the capillary fringe. The phytostabilization process is illustrated in Figure 4-32.



**Figure 4-25. Conceptual Cross-section of a Phytostabilization System**  
(Hauser et al., 1999; ET = evapotranspiration)

The proposed use of hybrid poplars for groundwater contaminant phytostabilization and treatment on EIA-1 is based on its rapid growth, extensive root system, groundwater uptake and transpiration attributes, long life spans, ability to grow in low-fertility soil, capabilities to release exudates that stimulate microbial activity and subsequent rhizosphere chemical material biodegradation, and uptake and in-plant transformation of organic compounds into less toxic metabolites. Poplars contain the enzyme nitroreductase, which can rapidly degrade explosives and other nitroaromatics. Carreira (1996) reported that nitroreductase and laccase enzymes completely degraded TNT to form new plant biomass (lignin) and reported the development of an immunospecific assay to screen native plants for nitroreductase activity. Advantages and disadvantages of phytostabilization are presented in Table 4-36.

**Table 4-36. Advantages and Disadvantages of Phytostabilization**

Advantages	Disadvantages
Phytostabilization is <i>in situ</i> , less disruptive, and cost-effective (typically one-third) compared to traditional remediation technologies.	Water removal is reduced during winter, which may allow contaminated water to migrate away from the capture zone.
These natural self-sustaining systems require minimal maintenance.	Complete year round containment of groundwater contaminants may not be possible.
Plant roots typically come into contact with a greater volume of soil than is possible with pumping wells.	The rooting depth of the selected vegetation limits groundwater removal.
Soil removal is unnecessary and disposal of hazardous materials or biomass is not required.	Climatic variables may influence effectiveness.
Revegetation enhances ecological restoration and soil erosion control.	If contaminant concentrations are too high plants may die. The toxicity and bioavailability of biodegradation products is not always known.
The effectiveness of the system may be enhanced by plant growth stimulation of other forms of phytoremediation such as phytodegradation and rhizodegradation.	Animals may damage plant and create a need to replant.

Of particular concern to this project is the placement of the phytostabilization system. If placed upgradient of the seepage slope bog there is the potential to dewater the wetland, which would initiate a successional change in vegetation dominance to terrestrial woody species and reduce habitat and water quality functions. It is critical that the poplars be planted down stream of the seepage slope bog and established to a density that does not pump excessive amounts of groundwater. The proposed location of the phytostabilization/treatment system up gradient of monitoring wells MW 94-62-04 and MW 94-62-05 is shown in Figure A-4. A description of the application specifications for the proposed phytoremediation system is presented in Appendix A.

#### *CE-EOD Open Detonation Unit Soil Disturbance Management*

The 200 × 400 foot CE-EOD open detonation (OD) unit is relatively void of vegetation because of the level of mission preparation and post-event activity exercised on the site and effects of open detonation overpressure on vegetative cover. Although the OD unit is on relatively flat land and is not prone to off-site erosion, it is important to minimize soil disturbance to protect adjacent areas that provide a buffer between the OD unit and the actively eroding EIA-1 site. To attempt to sustain complete vegetation cover on the site is an impractical goal; however, there are simple procedures that could minimize impacts to adjacent buffer areas and groundwater exposure to contamination including:

- Fill-in the existing open detonation pits with soil flush with the existing surface elevation
- Terminate open detonation pit construction
- Rotate surface flush open detonation events with the permitted area

Open detonation soil disturbance management is also discussed in Appendix A.

### **Debris Impact Potentials**

Alternative 3 proposes the recovery of TA C-62 surface UXO and other munitions debris from the CE-EOD OB/OD area to reduce a potential source of surface water and groundwater contamination potentials. The purpose of this BMP is to remove potential sources of surface water and groundwater contamination. TA C-62 lands within a 1,200 foot radius of the CE-EOD OB/OD unit would be cleared of surface and partly buried UXO and debris. Recovery operations along the western headwater of Blount Mill Creek would be limited to creek side areas along the southern portion of the test area; foot traffic would be excluded from the seepage slope bog to prevent extensive recovery disturbance of the sensitive wetland.

Although much of the debris identified on the test area is associated with the baseline expenditure, there is also likely a substantial amount of surface and subsurface debris that originated from TA C-62 historical missions performed over the last 57 years of recorded military use of the test area. The purpose of debris recovery operations is to reduce potential test area military mission land use restrictions and landscape management activities related to safety concerns and minimize potential contributions of UXO and munitions debris to groundwater and surface water contamination. From a safety standpoint, areas may be or may become so heavily littered with debris that portions of the test area may be determined to be unsuitable for troop ground training operations and proposed prescribed burning activities requiring ground personnel may also be inhabited.

#### **4.5.3 Alternative 4**

The implementation of Alternative 4 would include a 100 percent increase in all baseline mission expenditures with the exception of CE-EOD open detonation activities; therefore, no additional chemical material or debris impacts are anticipated.

#### **4.5.4 Chemical Materials and Debris Summary**

Chemical materials primarily in the form of air emissions, lead, and energetic materials are introduced to the environment of TA C-62 by CE-EOD OB/OD operations. Historic bombing of the target TT-1 is also identified as a likely source of explosives groundwater contamination. A summary of potential chemical materials consequences for the alternatives considered is presented in Table 4-37.

**Table 4-37. Alternatives 1 through 4 Chemical Material and Debris Summary**

Environmental Analysis		Alternatives		
Expenditure	Criteria	1 and 2 <sup>a</sup>	3 <sup>b</sup>	4
Air Quality				
Carbon monoxide	40 mg/m <sup>3</sup>	18 mg/m <sup>3</sup>	15 mg/m <sup>3</sup>	No Change
Nitrogen dioxide <sup>c</sup>	100 µg/m <sup>3</sup>	497 µg/m <sup>3</sup>	130 µg/m <sup>3</sup>	
Lead <sup>c</sup>	1.5 µg/m <sup>3</sup>	249 µg/m <sup>3</sup>	232 µg/m <sup>3</sup>	
Soil Quality – Mission Event Cumulative Lead	400 mg/kg	0.1 µg/m <sup>3</sup>	0.2 µg/m <sup>3</sup>	
Groundwater				
2,4-dinitrotoluene	Florida <sup>d</sup> = 0.20 µg/L	0.25 µg/L	Potential Reduction	No Change
4-amino-2,6-dinitrotoluene	Four times MDL	2.2 µg/L		
Nitroglycerin		3.7 µg/L		

<sup>a</sup> Estimated concentrations based on two 2,500 NEW detonation events

<sup>b</sup> Estimated concentrations based on five 1,000 NEW detonation events

<sup>c</sup> Atmospheric dilution and dispersion drastically reduce elevated nitrogen dioxide and lead air emissions concentrations.

<sup>d</sup> Drinking water standard

MDL = Method Detection Limit

Although the estimated air emission concentrations for nitrogen dioxide and lead are above the threshold criteria, the dynamic effects of atmospheric dilution and dispersion would drastically reduce emission concentrations within 15 minutes even during unfavorable weather conditions. Alternatives 1 and 2 chemical material and debris impacts of particular concern include:

- Direct exposure of CE-EOD open detonation event explosive residues to groundwater
- Target TT-1 historic UXO metal casing rupture or corrosion and release of explosive materials into the soil and water environment
- Potential phototoxicity of TNT reduction transformation products and metabolites to some aquatic species

Alternatives 3 proposes problem-specific chemical and debris BMPs designed to reduce the potential long-term effects of Alternative 1 and 2 mission related impacts on the environment while maximizing the capacity of TA C-62 to absorb and recover from mission activities. Specifically, Alternative 3 contaminant management BMPs could reduce long-term groundwater contamination potentials, increase energetic material biodegradation and immobilization, and maintain and protect wetland water quality functions.

## 5. LIST OF PREPARERS

Table 5-1 lists the multi-disciplinary team of individuals that were instrumental in the planning, production, and presentation of this document.

**Table 5-1. List of Preparers**

<b>Name</b>	<b>Title</b>	<b>Degrees</b>	<b>Years Experience</b>
Beshore, Eric A.	Program Manager	B.A. Architecture; M.S. Civil Engineering	30 years management in environmental field
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Daniels, Karen L.	Environmental Scientist	B.S. Biology; M.S. Fisheries; M. Applied Statistics	22 years environmental science
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## Ordnance Metal Casing Corrosion

## **APPENDIX A**

### **PROPOSED ALTERNATIVE 3 RANGE SUSTAINABILITY BEST MANAGEMENT PRACTICES**

## **PREFACE**

The sustainability of military missions on TA C-62 is partly dependent on active stewardship of the test area air, water, soil, and biological resources. The proposed Best Management Practices (BMPs) discussed in the following sections outline a series of proactive solutions to adverse resource impacts that if left unchecked could jeopardize the long-term range sustainability of TA C-62. The range sustainability BMPs are presented as practical options for addressing TA C-62 specific concerns and not a mandate of action to be performed. The BMPs range from simple, low-cost solutions to BMPs requiring an initial resource investment. The emphasis of these BMP options is to foster the development and maintenance of self-sustaining ecosystems capable of absorbing and recovering from periodic mission impacts and empowering flexibility in the development of long-term test area mission support capabilities.

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## 1. EROSION IMPACT AREA RESTORATION

This section identifies a series of complementary BMPs designed to restore the ability of degraded terrestrial ecosystems to absorb and recover from mission activities and restore mission operation support capabilities to damaged lands. The proposed EIA restoration BMPs focus on restoring the physical and biological ecosystem components of damaged stream slopes, obliterating problematic road segments, and relocating road access to low impact areas.

### 1.1 INTRODUCTION

TA C-62 Erosion Impact Areas (EIA) 1 through 4 have been identified as test area locations experiencing accelerated soil erosion that is adversely impacting the mission servicing capability of the test area and natural environment. Historically, mission related activities have been the primary source of surface disturbance and subsequent erosion that in some cases has proceeded unabated for decades. Mission activities identified as being of greatest consequence to soil erosion include vegetative management roller drum chopping, CE-EOD OB/OD operations, maintenance of aircraft gunnery target TT-3, and test area roads.

Cumulatively these sites have removed the capability of impacted locations to support other mission activities and degraded the condition of terrestrial, wetland, and aquatic habitats. Left unchecked the erosive process will continue to consume test area lands and degrade receiving wetlands and streams. In all instances, there is a direct connection between a mission related activity and impacts to wetlands and streams. The loss of vegetative buffers between mission sites and receiving streams eliminated by erosion also increases the potential for off-site contamination by chemical materials and munitions debris. Recommended BMPs could reduce current

EIA soil erosion rates ranging from ~70 to ~116 tons/acre/year to minimal erosion rates (<1 ton/acre/year) characteristic of native grassland. In one instance, soil erosion associated with EIA-2 has destroyed a prehistoric archaeological site.

Alternative 3 provides customized Best Management Practices (BMPs) for stabilizing eroded slopes, restoring the mission support capability of impacted lands, and revitalizing self-sustaining native ecosystems. A detailed discussion of the characteristics of each EIA is presented in Chapter 3 beginning on page. The three BMPs identified for restoring EIA 1 through 4 include 1) stream slope restoration, 2) vegetative runoff barriers, and 3) road decommissioning and construction. A general EIA prescription is provided in Table A-1 followed by a detailed description of BMP design and implementation procedures. A topographic cross-section and feature tie-in design survey would be required to develop application specifications for the recommended BMPs. Most of the prescribed restoration techniques in Table A-1 are based on BMPs described in the Eglin Air Force Base Range Road Maintenance Handbook (U.S. Air Force, 2001). The handbook can be viewed at <https://em.eglin.af.mil/road/bmp/>.

**Table A-1. EIA 1 Through 4 Restoration Prescription**

<b>Problem</b>	Unstable slopes void of established vegetation ground cover and soil binding root systems experience unabated soil erosion and soil degradation.
<b>Site Character</b>	<p>Direct disturbance of the slope and/or a concentration of surface runoff created conditions that exclude ample vegetative coverage of the impacted slope.</p> <p>Erosion has removed all or a significant portion of the topsoil from the slope. In many cases, geologic formations such as the Citronelle layer have been exposed at the surface.</p> <p>In most cases, the exposed subsurface soils are deficient in fertility and soil structure requirements necessary to support vegetation. Concentrated water flow over unprotected ground results in the detachment, suspension, and transport of soil materials and formation of rills and gullies.</p>
<b>Treatment Strategy</b>	<p>Treatment of slopes without established vegetation requires the application of BMPs that:</p> <ul style="list-style-type: none"> <li>• Manufacture stable slope gradients</li> <li>• Recondition soils</li> <li>• Reinforce and protect slopes with permanent vegetation</li> <li>• Manage concentrated slope runoff volume and velocities.</li> </ul>

**Table A-1. EIA 1 Through 4 Restoration Prescription Cont'd**

<b>Site Investigation</b>	Identify the land area that is contributing runoff to the treatment slope and record the soil type(s), land use, type of cover, and man-made features. Examine topographic maps to determine drainage patterns that may be concentrating water runoff and investigate the site and record evidence of seepage flows within the slope profile. Determine if sensitive species and cultural resources are within the realm of influence. Perform cross-section topographic survey of each EIA for BMP designs.
<b>Grade Stabilization</b>	Based on site investigations, design and construct stable side slopes using the Slope Grading techniques (page A-3). Long gentle slopes may need minimal or no slope gradient alteration work, whereas short steep slopes may require moderate to extensive slope grading. On long gentle slopes, try to achieve a 5:1 or flatter slope gradient. On strongly sloping to steep slopes, the target slope gradient is 3:1 or flatter. Minimize the disturbance of other areas to the degree possible. Remove and store topsoil of undisturbed areas that will be incorporated into the slope for use during final seedbed preparation. After construction is complete, perform a construction check survey and verify that slope gradient is within tolerances. Be sure to perform the construction check survey while equipment and operators are on-site, preferably during the construction process.
<b>Soil Conditioning</b>	<p>Following slope grading construction check, perform soil sampling and testing using the soil test kit materials and techniques as directed by the Soil Quality Assessment Procedures in Appendix B (page B-34). Duplicate soil testing procedures on a similar undisturbed benchmark site for comparative analysis (page B-36).</p> <p>Based on site investigations, soil testing results, and planting mix selected (see revegetation plan on the next page) perform the following to treatment side slopes:</p> <ul style="list-style-type: none"> <li>• Soil Testing..... A-4</li> <li>• Soil Structure Amendment..... A-4</li> <li>• Final Seedbed Preparation..... A-5</li> <li>• Liming Acid Soils..... A-5</li> <li>• Composting..... A-6</li> <li>• Mycorrhizal Inoculation..... A-7</li> </ul> <p>If a sufficient amount of topsoil was recovered during side slope construction, mycorrhizal inoculation is not required. Apply soil amendments in as few passes as possible and combine operations whenever practical.</p>
<b>Revegetation</b>	All disturbed land surfaces will be revegetated as soon as possible after final seedbed preparation. Instructions for seedbed preparation, planting methods, seeding rates, revegetation protocols, and vegetation management are presented in Stream Slope Restoration beginning on page A-2. Based on a determination of dominant soil moisture conditions, disturbed slopes will be planted to a droughty, dry, or wet soil seed mixture (page A-9). Based on design flow velocities, vegetative runoff barriers will be established on sensitive slopes as instructed on page A-10. Based on site conditions and vegetation, apply mulching materials; compost mulch (page A-8) is a preferred mulching material for most circumstances.

## 1.2 STREAM SLOPE RESTORATION

Erosion control is based on the application of relatively simple yet effective measures that prevent the displacement of soil particles by rainfall impact, water flow, or wind by increasing the resistance to detachment and/or reducing the transport capacity of stormwater runoff. The principal means of achieving this objective is to create an environment that promotes the establishment of long-term, self-sustaining vegetative communities that are naturally engineered to anchor soil and diminish the erosive energy of flowing water.

Three principles for restoring Erosion Impact Areas presented in the general order of design and implementation follow.

**1. Manufacture Stable Slope Grades:** A slope, which is inherently unstable, will not support satisfactory vegetative cover until it has created a stable angle of repose whether by the process of erosion or mechanical reconstruction. Slope grading is employed as a mechanical means of manufacturing a stable angle of repose that minimizes erosion potential and encourages the establishment of vegetation.

**2. Recondition Disturbed Soils:** As a consequence of unabated erosion, the soil of Erosion Impact Unit 1 has become damaged structurally and likely depleted of the soil components required for maintaining a healthy soil environment and supporting vegetative growth. It is the intention to restore the self-sustaining capacity of soil environments by implementing practices that promote soil structural stability; stimulate an increase in the diversity, populations, and activity of soil organisms; restore

soil humus components; and promote nutrient recycling and soil water retention.

**3. Establish Permanent Vegetation:** Vegetative covers provide the best-known soil protection. Stable vegetative cover minimizes the effects of raindrop impacts, reduces the velocity of runoff, hold soils in place, tends to be self-healing, is generally less expensive compared to structural features, and is often the only practical long-term solution for stabilization and erosion control on most disturbed sites. Grasses are particularly well adapted to erosion control. A 10,000 square foot patch of dense sod can contain up to eight million individual grass plants with an estimated three billion miles of root system (Yost, 1996). The shielding effect of the plant canopy and leaves is augmented by roots and rhizomes that hold the soil in place, improve the soil's physical condition, and increase the rate of infiltration, further decreasing runoff. Native grasses and forbs are the primary species for revegetating the disturbed area. Native species will be used to establish permanent vegetative covers that eliminate all bare ground to the degree possible.

The practices employed to achieve the desired results include slope grading, soil reconditioning, revegetation, and compost mulching. The procedures for implementing these practices are presented in the following sections.

### 1.2.1 Slope Grading

Slope grading is the mechanical manipulation of disturbed slopes to gradients that are less susceptible to erosion and encourage the establishment of vegetation. The purpose of slope grading is to stabilize soil particles, decrease stormwater runoff volume and velocities, reestablish slope physical features to predisturbance conditions to the degree possible, increase water infiltration and conservation, and create a soil environment amenable to vegetative growth.

Slope gradients drastically affect potential erosion rates. Multiplying the slope by 4 roughly results in 2 times the velocity of flow, 4 times the eroding power, 32 times the material carried, and 64 times the size of material that can be moved. Grading and shaping disturbed slopes is used in combination with other practices to reduce erosion and sediment potentials and foster the establishment of permanent vegetative covers.

The reestablishment of slopes to stable gradients is an initial step in the treatment of Erosion Impact Areas 1 and 2. The overall objective is to establish a slope

with the flattest gradient possible within design constraints. Flattening a steep slope involves adding more fill or taking out more cut material. Once a stable angle of repose is reached, there is little benefit in further flattening. Changes in slope angles should be rounded in shape to reduce erosion potential and to blend with the natural landscape. Rounding is particularly important at the top of cut excavations.

Development should fit existing topography as much as possible so that land disturbance is minimized. Slope steepness and excessive slope lengths should be kept to a minimum. Benches, steps, or contour furrows can be installed on long slopes to break up the slope length. A bench should be graded back towards the slope and drained with a gentle gradient to a stable outlet. Drainage from upland areas should be diverted away from exposed slopes.

- To the degree possible, slopes shall be regraded to an overall gradient of 4:1 or flatter to increase the success of erosion and runoff control practices.
- Disturb only those areas necessary for construction. Flag areas not to be disturbed.
- Utilize the surrounding natural slopes as a benchmark for designing slope lengths, angles, and contours that are compatible with endemic hydrology and design criteria.
- Areas to be graded shall be cleared, grubbed to remove trees, vegetation, roots and other objectionable material, and stripped of topsoil. Stripped topsoil shall be saved in a protected location for reuse.
- Roughen the surface of all slopes during the construction operation to retain water, increase infiltration, and facilitate vegetation establishment.
- Graded areas can be roughened by driving a bulldozer up and down the slope so the dozer treads (cleat tracks) create grooves perpendicular to the slope. The tread indentations trap seeds, which encourages plants to establish, and they also slow water velocities.
- The cost of slope grading is dependent on the volume of soil that must be moved and slope reshaping required.

### 1.2.2 Soil Conditioning

Soil conditioning is the physical treatment and application of soil amendments to restore soil productivity, reduce soil erosion potentials, and foster

the establishment and growth of viable, self-sufficient vegetative communities. Sites that have experienced severe alteration of the physical and chemical nature of the soil exemplify relatively sterile soil environments that are unable to sustain adequate vegetative cover. The purpose of soil conditioning is to restore the physical and chemical nature of degraded soil environments to a level of productivity that will stabilize the soil against erosion, sustain soil flora and fauna, and support vegetative cover without long-term human intervention.

The soil must be able to sustain long-term plant growth and not just the flush growth of temporary cover that dies out under harsh conditions. To achieve this state, the soil must have a pH suitable for the target vegetation, it must have an adequate stockpile of nutrients, and it must have sufficient organic matter to retain moisture and nutrients and maintain a diversity of essential soil microbes. An absence or depletion of one or all of these factors will result in the long-term failure of planted vegetation.

Guidelines have been developed for reconditioning damaged soils to a level of productivity that will support viable, self-sustaining vegetative communities and minimize surface erosion potentials. Soil conditioning practices enclosed in this section include soil testing, soil structure amendment, liming acid soils, composting, and mycorrhizal inoculation.

### Soil Testing

Soil testing is a procedure for determining the physical and chemical nature of the soil in advance of establishing vegetation. However a soil test is only as accurate as the sample taken and is totally dependent upon the attention given to gathering a representative soil sample. The steps to be implemented in the collection of soil samples for field and/or laboratory testing are as follows:

1. Use a stainless steel spade or soil auger to collect 20 samples to a depth of 6 inches from randomly selected locations representative of the treatment area. A soil auger works best in compacted or cemented soil likely encountered at the site. Use a plastic bucket to collect the samples. Be sure not to contaminate the samples with soil from another area. At each sampling site clear the area of any surface debris (leaves, twigs, roots, litter, etc.). Do not sample the sediment deposits at the toe-of-slope adjacent to the stream.
2. Mix the samples well in a precleaned plastic pail or bucket to form a representative composite. For small areas, one composite may be sufficient, whereas larger areas may require several composites. It is important that composite soil samples be as similar as possible, otherwise analysis of a composite sample will characterize an average or intermediate soil that does not exist.
3. Remove a 1 to 2 cup sample from the treatment area composite and immediately place the sample in the glass or plastic container. Greater amounts may be needed when physical properties such as texture or available moisture are to be measured.
4. Label the sample with the date and location of collection. If the sample is to be sent to a laboratory for analysis, keep the composite sample(s) on ice in a cooler or frozen until submitted to the laboratory.
5. Send the samples to the laboratory as soon as possible and have it tested for pH.

In the case of TA C-62 EIAs, the topsoil and a significant portion of the subsoil have been removed leaving a relatively sterile, barren geologic layer on which vegetation will have to be restored. Based on native fertility levels, magnesium, nitrogen, phosphorus, and potassium are likely to be low. Additions of high levels of nitrogen (N), phosphorus (P), and potassium (K) tend to favor the establishment and growth of introduced, exotic, and weedy species.

The target native plants to be planted on the site are relatively tolerant of low fertility; therefore additions of these nutrients using commercial fertilizers are not anticipated. Of more importance is testing for pH. The soil sample is likely to be strongly to extremely acidic and require amendment by liming.

### Soil Structure Amendment

The physical structure of the soil is critical to revegetation success. Limiting conditions of the soil associated with soil texture, compact, and aggregate stability can result in the failure of vegetation efforts. The procedures and equipment described in this section is categorized as ground preparation and final seedbed preparation. Specialized equipment is used to physically alter the surface and subsurface soil structure, incorporate soil amendments, and create a seedbed ready for planting.

### ***Ground Preparation***

The implements used during ground preparation operations provide the initial structural reconditioning of soils that may have experienced severe erosion and be characterized by surface debris and dense and/or compacted soil layers that restrict water movement and root penetration. The purpose of the chiseling, subsoiling, and offset disking is to improve soil structure, water infiltration and percolation, and soil aggregation, reduce erosion hazards, incorporate soil amendments, and create an adequate seedbed for planting.

#### ***Chisel Plow***

Chisel plows are curved shanks mounted along a frame member or toolbar with a spring-loaded clamp. As the chisel plow is pulled through the soil, the action of the shanks scarifies the soil and opens it up. Chiseling is the mechanical loosening of the soil that shatters restrictive and/or compacted soil with minimal mixing of soil layers and without inverting the soil.

The purpose is to improve water and root penetration, soil aeration, water and nutrient availability to plants, and soil aggregation of the seedbed prior to revegetation. Most heavily eroded sites will require chisel plowing before they can be revegetated. Chiseling is applied to restrictive layers less than eight inches deep using a tractor or dozer drawn chisel plow.

#### ***Offset Disking***

Offset disks are designed to chop and turn surface trash under and/or incorporate soil amendments. As the disks are towed over the surface, the front gang turns one way and the rear gangs turn the opposite direction, giving a double disking action. With each pass, trash is chopped and incorporated into the soil. Disks are also effective in preparing a seedbed, breaking up surface compaction, and incorporating soil amendments such as compost, fertilizer, lime, and mycorrhizal inoculum. Disking will only be performed on dry soil on or near the general contour of the land; disking wet soil will cause more soil compaction than any other tillage operation.

### ***Final Seedbed Preparation***

Secondary tillage and soil packing equipment is used to prepare a pulverized, firm, smooth seedbed free of unwanted plant competition ready for planting. Soil amendments may also be distributed and incorporated during secondary tillage operations. Final seedbed

preparation secondary tillage equipment includes spike tooth harrows and cultipackers.

#### ***Spike Tooth Harrow***

Spike tooth harrows consist of short, straight teeth of coil spring tynes attached to a frame that are used to smooth out rough ground and/or cover broadcast seeds on ground too trashy for drilling. The tynes are often set at a slight angle rearward to prevent trash buildup. Spike tooth harrows are pulled over the area to be treated. The tynes penetrate the surface a few inches and break up large pieces of soil, forming many small crevices.

They can be used to cover broadcast seed without completely destroying the cover or nurse crop. However, they are relatively ineffective in covering seed to a uniform depth. Harrows equipped with coil spring tynes vibrate as they are moved to increase the smoothing action.

#### ***Cultipacker***

Cultipackers are implements towed behind tractors that firm up seedbeds prior to planting or to cover broadcast seeds. The cultipacker breaks up clods, smooths the surface, improves moisture availability, and ensures adequate seed contact with the soil. They are frequently combined with other tillage implements such as the spike tooth harrow and/or seed broadcasters. The standard cultipacker has rollers with grooves or spikes spaced along a long horizontal axle at regular intervals with the axle attached to a heavy frame. Additional weight can be added to some frames. This type implement is poorly adapted to rough, steep terrain.

#### ***Liming Acid Soil***

The purpose of liming acid soils is to raise the pH to a target pH to promote plant growth and establishment. Lime is a material that increases pH upon contact with the soil. It is composed of finely ground carbonates of calcium and magnesium. Typically, pH changes that exceed the buffering capacity of the soil are a result of base saturation imbalances of calcium and/or magnesium bases. Liming products extracted from limestone include calcitic and dolomite limestone, burnt lime, and hydrated lime.

An advantage of limestone is that it dissolves quicker than quick lime or hydrated lime, thus lasting longer. A disadvantage is that its solubility is limited, such that alkalinity higher than approximately 400 mg/L as calcium carbonate (CaCO<sub>3</sub>) is rarely achieved.

Based on soil pH testing results, apply dolomite at limestone at the laboratory recommended rate to achieve a target pH of 5.5 for native species revegetation. Dolomite is a mineral composed of calcium and magnesium carbonates; pure dolomite contains 40% to 45%  $\text{MgCO}_3$  and 54% to 58%  $\text{CaCO}_3$ . Dolomitic limestone typically has a concentration of 15% to 20% magnesium carbonate ( $\text{MgCO}_3$ ). Many northwest Florida soils are low in magnesium; the application of dolomite raises the soil pH and provides magnesium as an available nutrient.

General guidelines for lime application are as follows:

- Do not lime unless the field test shows that limestone is needed.
- Lime can be applied any time during the year, but the period between September and November is preferred.
- For applications of 50 pounds per 1,000 square feet or greater, divide the total amount into split applications, apply one half in the spring and the other half in the fall.
- Apply dolomite limestone to a well-prepared seedbed or site that has been thoroughly aerated. This enables the lime to react more quickly.
- When liming a new seeding, ground or pelletized lime is applied uniformly to a dry soil surface at the recommended rate and incorporated into the soil to a depth of four to six inches. For best results, apply half of the material in one direction and the remainder at a right angle to the previous application.
- Retest the site every three months to monitor changes in pH; it may take up to a year before the target pH is achieved.

Dolomite is generally slower reacting than calcitic limestone.

### Composting

Organic matter and humus are terms that describe somewhat different but related things. Organic matter is the organic fraction of soil including plant, animal, and microbial residues, fresh and all stages of decomposition, and relatively resistant soil humus; in simple terms, anything that contains organically derived carbon. Humus is only a small portion of the organic matter and is considered the relatively stable end product of organic matter decomposition.

Organic matter effectively stabilizes soil aggregate formation, allows water and air movement, reduces

erosion, increases soil nutrient content and prevents nutrient leaching, suppresses plant diseases and pests, and increases water retention, and reduces or eliminates the need for commercial fertilizer. Organic matter is the reservoir for soil nutrients with 90 percent of soil nitrogen (N) and phosphorus (P) being held in organic matter (Elliott and Cambardella, 1991).

The water holding capacity of two soils of identical mineralogy and grain size distribution will generally be higher in the soil with higher humus content (Wershaw, 1993). Primarily as a consequence of generally low organic matter (<2%), most of the upland sandy soils on Eglin AFB have relatively low fertility, low water holding capacity, high permeability, and are prone to nutrient leaching.

As such a strong determinant of soil stability, fertility, and viability, it is crucial that the amendment of exposed subsoil, unweathered geologic formations, and topsoil deficient in organic matter be incorporated as a primary soil conditioning operation. Primary means of replenishing organic matter in degraded soils is through the addition of mature compost and organic fertilizers.

Composting is a managed system that uses microbial activity to degrade raw organic materials to a relatively stable end product free of offensive odors and reduced in quantity (USEPA, 1998). Mature compost is defined as the highly stabilized and sanitized, finished product of composting that is beneficial to plant growth and has a reduction of organic matter of 40% to 60%. It also has a diversity of microbial species and populations much higher than fertile, productive soils (Dunlap, 1997).

Compost is rich in humic materials, which persist in the soil for decades to centuries. The result is a long-term improvement in soil structure, whereas raw wastes added to the soil quickly lose their organic matter and degrade within a few years. This is why some vegetation efforts fail within two to three years after planting.

Improving the structure of compacted soils may require up to 20 percent by weight of organic materials. The high rates of raw organic materials required could introduce excess nutrients such as nitrogen. Compost releases nutrients much slower compared to raw wastes, which allows higher application rates without producing excess nutrient levels.

Mature compost such as yard waste and mushroom substrate is also more effective for revegetating steep

slopes than raw organic materials or uncomposted biosolids. Its stability and tendency to slowly release nutrients provides a good medium for plant establishment (USEPA, 1998).

Yard waste compost is typically comprised of shrub and tree debris, grass clippings, weeds, and ground Christmas trees originating from residential, commercial and institutional landscaping activities. The finished compost is often screened and cured with coarse stock sold as a surface mulch and fine stock sold as a soil amendment for incorporation. Yard trimming composts normally have a neutral pH, salinity ranging from 3.5 to 10 dS/m, high organic content averaging 70 percent, high available potassium, moderate phosphorous and calcium, variable nitrogen (depending of the amount of leafy material or grass), and low levels of heavy metals. Plastic, glass and weeds are potential concerns.

It is important to understand that compost must exist in a mature and stable condition, otherwise the applied organic materials could cause additional soil stress that may jeopardize revegetation success and increase potential erosion problems. Mature, stable compost has experienced a level of biological activity that results in a substance with the following characteristics:

- Free of organic phytotoxic substances that can adversely affect seed germination or plant growth.
- Consumes almost no nitrogen or oxygen and generates little carbon dioxide or heat; compost that is hot (>120 °F) or becomes hot after wetting is unacceptable.
- A dark brown or black color and a soil-like or musty odor; sour or putrid smelling compost is unacceptable.
- Not recognizable grass or leaves.

General guidelines for mature compost applications are as follows.

- Apply compost at a rate of 6 cubic yards per 1,000 feet.
- Incorporate the compost into the soil using an offset disk to a depth of three to six inches. Thoroughly incorporate the amendment to avoid pockets or layers of organic material. Lime and other organic fertilizers may also be incorporated at this time.
- Following incorporation, the site is planted to the target vegetation.

### Mycorrhizal Inoculation

Typically, the success of many revegetation projects is measured on the basis of some aboveground practice. However, the component of the living soil beneath our feet is as important as the more conspicuous aboveground features. The collective of macro fauna (insects, worms, and small mammals) and micro fauna (protozoa, amoebae, nematodes, microarthropods, bacteria, and fungi) function directly or indirectly in the support of aboveground vegetation. These soil organisms perform majorities of nutrient cycling transformations that occur in the soil. Of these, the symbiotic relationship between some plant root systems and mycorrhizal fungi is of particular importance (Fitter and Garbaye, 1994).

Mycorrhizal fungi exist in mutualistic or symbiotic relationships with plant roots utilizing exudates supplied by roots for energy and providing host plants with a extensive hyal network that dramatically extends the relatively limited range of plant roots in capturing water and nutrients. The maintenance of a functional plant root and mycorrhizae fungi association is beneficial to plants and the overall soil environment. Mycorrhizae hyal filaments mediate nutrients cycling, control soil microbiology, dictate plant community composition, and hold soil together.

As such a dominant force, mycorrhizal network destruction is a central event of soil disturbance. The benefits of mycorrhizae include increased plant growth and tolerance of plants to drought, high soil temperatures, soil toxins, extremes of soil acidity caused by high levels of sulfur or aluminum, fungal and bacterial root pathogens, and parasitic nematodes.

Mycorrhizal associations have been divided into three major groups: ectomycorrhizae, vesicular-arbuscular (VA) or endomycorrhizae, and ectoendomycorrhizae. Endomycorrhizae is the most common, forming associations with members of at least 200 plant families (Miller, 1985). Vesicular-arbuscular (VA) mycorrhizae, the predominate grass forb endomycorrhizae, has be shown to be obligatory or strongly dependent for grass species such as big bluestem (*Anderpogon gerardii* var. *gerardii*), little bluestem (*Schizachyzrium scoparium*), Indiangrass (*Sorghastrum nutans*) and Switchgrass (*Panacium vergatum*) (Hetrick et al., 1988).

EIAs 1 through 4 are candidates for mycorrhizal inoculation because these areas have experienced the loss of topsoil and have been barren of vegetative cover for an extended period of time. It is important to



remember that mycorrhizal fungi are slow to disperse on their own, and they cannot grow without a host plant.

It is important that whatever the method of application, the inoculum should be within easy reach of new seedlings and that seedling growth takes place soon after the inoculum is applied. Since the emphasis of this effort is revegetation with grasses and forbs, inoculation will focus on the use of vesicular-arbuscular mycorrhizae (VAM). As a general guide, VAM inocula *Glomus etunicatum* and *Gigaspora margarita* are effective in slight to strongly acid conditions.

Commercial VAM is supplied by a number of vendors in a variety of media, including sand vermiculite and clay granules, and recommended application rates. These materials may be handled by broadcasters, fertilizer boxes, and drill seeders. The most common inoculum application techniques are surface broadcasting and banding.

Broadcasting consists of spreading inoculum media on the soil surface, then mixing it into the soil to a depth of four to six inches before or at seeding. Since only inoculum immediately adjacent to seeds will colonize the seeds, large amounts of inoculum may be needed for broadcasting to ensure complete coverage.

Banding inoculum only requires a third of the inoculum needed for broadcasting since inoculum is placed in a band in a concentrated area near developing roots; side-dressing is also effective with seedlings or seeds. Banding is a time and labor saving technique compared to other methods, but it does require a machine applicator.

Depending on the application technique and amount of inoculum required, application costs can range from \$200 to thousands of dollars per acre. However an important consideration is that no job is as expensive as the one that must be redone several times.

### Compost Mulch

Compost mulching is a simple, relatively inexpensive practice that effectively improves soil conditions, reduces erosion, and enhances the establishment of viable, self-sustaining plant communities. Mature compost applied to sloped areas has been shown to be more effective than straw or hydromulch in reducing erosion by enhancing planted or volunteer vegetation growth.

Mature compost tends to be self-adhesive and forms a flexible, noneroding blanket when applied to the soil surface. It also facilitates thicker, more permanent plant growth due to its ability to improve and stabilize the long-term structure, fertility, and microbial activity of the soil.

Plant nutrients are more readily available over extended periods because of the slow nutrient release rates of humic materials. The high water holding capability of compost also improves plant survival during droughts (USEPA, 1998).

In U.S. Environmental Protection Agency studies (1998) compost mulched plots with no added fertilizer exhibited superior seedling growth, natural revegetation, and soil stabilization response compared to straw mulch and untreated controls. Volunteer herbaceous ground cover ranged from a high of 95 percent for compost treatment to a low of 45 percent on an untreated control.

It was concluded that compost mulching is consistently superior to straw mulching for revegetating severely disturbed sites. The combination of incorporated compost plus compost mulch showed both superior survival and growth of seedlings.

Select a mature, stable yard waste type compost screened to 0.5 to 0.75 of an inch and apply to the surface at a rate of 3 cubic yards per 1,000 square feet. If properly applied, compost mulching requires no maintenance. Periodic inspections will assure the intended purposes will be met.

### 1.2.3 Revegetation

Revegetation is the establishment and maintenance of perennial vegetative cover. For the purposes of this document, revegetation plants are limited to grasses and forbs. The purpose of revegetation is to regenerate the naturally engineered capability of stable, self-sustaining plant communities to reduce soil erosion and sedimentation and improve soil quality, water quality, and wildlife habitat.

The overall objective is to recondition and stabilize the eroded slopes using native grasses and forbs and foster the natural invasion of woody species over time. The grasses were selected primarily for the tolerance of low fertility, acidic pH, and droughty conditions, resistance and/or tolerance for fire, and soil fertility building and soil binding attributes.

The revegetation of drastically disturbed stream slopes fit into three general categories: droughty, dry,

or wet soil conditions. Under most circumstances, the surface soils on TA C-62 can be categorized as dry or droughty. However, some areas may experience periodic or long-term wet mesic conditions as a result of groundwater seepage, runoff ponding, or occasional flooding as may occur at stream crossings. Mesic soils remain moist for a significant but sometimes-short portion of the growing season.

Droughty sites are characterized as excessively dry, acidic, sandy (>95% sand), sterile soils that have been barren of vegetative cover for an extended period of time. The initial stabilization of these critical sites may best be achieved by planting bitter panicgrass. Establishment of bitter panicgrass is limited to planting bareroot shoots (tillers) and rooted or unrooted stem cuttings.

Eastern gamagrass, Virginia wildrye, and switchgrass can withstand periodic flooding throughout the growing season, but will not grow in standing water.

Big bluestem can withstand periodic flooding, but does not like to be wet for extended periods. Little bluestem and switchgrass are adapted to dry upland sites, and bitter panicgrass is best adapted to droughty sterile sites.

The seeding mixture species and rates for mechanical seed drilling are presented in Table A-2. Based on the percent of PLS per pound, increase the bulk field planting rate to achieve the desired PLS per pound as presented in Table A-1. Adjust seeding rate to accommodate the selected seeding method. Conventional broadcast seeding typically requires 25% more seed than drill or air seeding.

Droughty sites are characterized as excessively dry, acidic, sandy (>95% sand), sterile soils that have been barren of vegetative cover for an extended periods. Initial stabilization of these critical sites may best be achieved by planting bitter panicgrass (Figure 3-44f).

**Table A-2. Slope Revegetation Seeding Mixtures**

Species	Percent of Mixture	Seeds/ft <sup>2</sup>	Pounds PLS/Acre**
Droughty Soil Mix			
Bitter Panicgrass	Plants are established using freshly dug bareroot shoots and rooted and unrooted stem cuttings.		
Dry Soil Mix*			
Big Bluestem	20	8	2.10
Indiangrass	20	8	2.00
Little Bluestem	15	6	1.00
Black-eyed Susan	15	6	0.15
Virginia Wildrye	10	4	1.80
Switchgrass	5	2	0.20
Showy Partridge Pea	5	2	0.60
Total		40.00	7.85
Wet Soil Mix*			
Virginia Wildrye	40	16	7.30
Big Bluestem	30	12	3.15
Switchgrass	20	8	0.90
Showy Partridge Pea	10	4	1.17
Total		40.00	12.52

\* Seed drill seeding rates

\*\* Actual pounds seeded per acre adjusted for percent PLS for each species

Establishment of bitter panicgrass is limited to planting bareroot shoots (tillers) and rooted or unrooted stem cuttings.

1. Use a walk-behind trencher to produce a 6 inch by 6 inch planting trench along the contour for slope plantings. Stagger the rows 2 to 3 feet apart.

2. Recondition the trench soil based on soil testing by adding lime as necessary to a target pH of 5.5. If the seedbed is amended with conventional fertilizer, add 0-24-24 at a rate comparable to 100 pounds per acre. Nitrogen should not be applied at planting.

3. Plant freshly dug bareroot tillers or rooted stem cuttings 8 to 10 inches deep and 2 feet apart, backfill the trench, and firm up the soil. Take care not to bend the roots upward during planting.
4. Unrooted cuttings are planted three to a hole in staggered rows 2 to 3 feet apart with holes 2 feet apart in each row. Potted plants are planted 8 to 10 inches deep and 2 to 3 feet apart.

On steep slopes, additional soil stabilization measures such as mulch or erosion control blankets may be required. Once the site is stabilized, other desired natives species can be planted.

### 1.3 VEGETATIVE RUNOFF BARRIER

A runoff barrier is a vegetative or structural feature installed on the land to intercept and diffuse the erosive energy of concentrated and sheet flow runoff and reduce subsequent sediment loads. The practices are also effective in improving the overall condition of the land and extending the efficiency and life of other BMPs.

Vegetative barriers are applicable to EIA 1 through 4 but have particular utility for EIA-3 adjacent to gunnery straffing target TT-3. Other than the road surface at EIA-4, the gunnery target is the only stream slope restoration that will have a sizable area where vegetation would not be planted. The target surface of TT-3 must remain barren to facilitate pilot alignment during training and post training clean-up operations. The maintenance of a barren target surface requires special consideration of the inevitable sheet erosion and sediment transport potential of the target surface.

#### 1.3.1 Introduction

Vegetative barriers or grass hedges are narrow, parallel rows of stiff, erect, densely tillered grasses planted close to the slope contour or across a waterway that functions as a physical barrier to impede water flow and sediment transport. They are an inexpensive, biological, conservation technology compatible with a diversity of erosion, runoff, and sediment control practices.

Grass hedges intercept and release stormwater runoff in a manner that:

- Facilitates the development of natural broad-based bioterraces that reduce slope lengths and gradients by adding sediment layers upslope of the hedgerow.

- Reduces flow volumes and velocities by dispersing concentrated flow and promoting water detention and soil infiltration.
- Redirects flows to controlled discharge points or buffer areas.
- Reduces the loss of soil moisture, planted seeds, and soil amendments.
- Traps sediments and soluble contaminants.

When runoff reaches the vegetative barrier, it slows down, spreads out, drops its sediment load, and oozes through the grass hedge with a significant portion of the water soaking into the land along the way. This is different from a diversion in that the diversion diverts and channelizes the water flow. Coarse, stiff, hedge-forming grasses can withstand high water flows that would bend and overtop finer vegetation. Vegetative barriers are also resilient to failure because water passes over a broad area secured with perennial roots.

The result is managed water flow, stabilization of slope and waterway soils, and improvement of the efficiency and life of other best management practices. Water is temporarily impounded and filtered rather than conveyed, which eliminates the need for channel design and maintenance. Reduced runoff volume, velocity, and sediment loads significantly reduce overall erosion and sedimentation potentials and improve biological site conditions (Farek and Lloyd-Reilly, 2000; Kemper, et al., 1992).

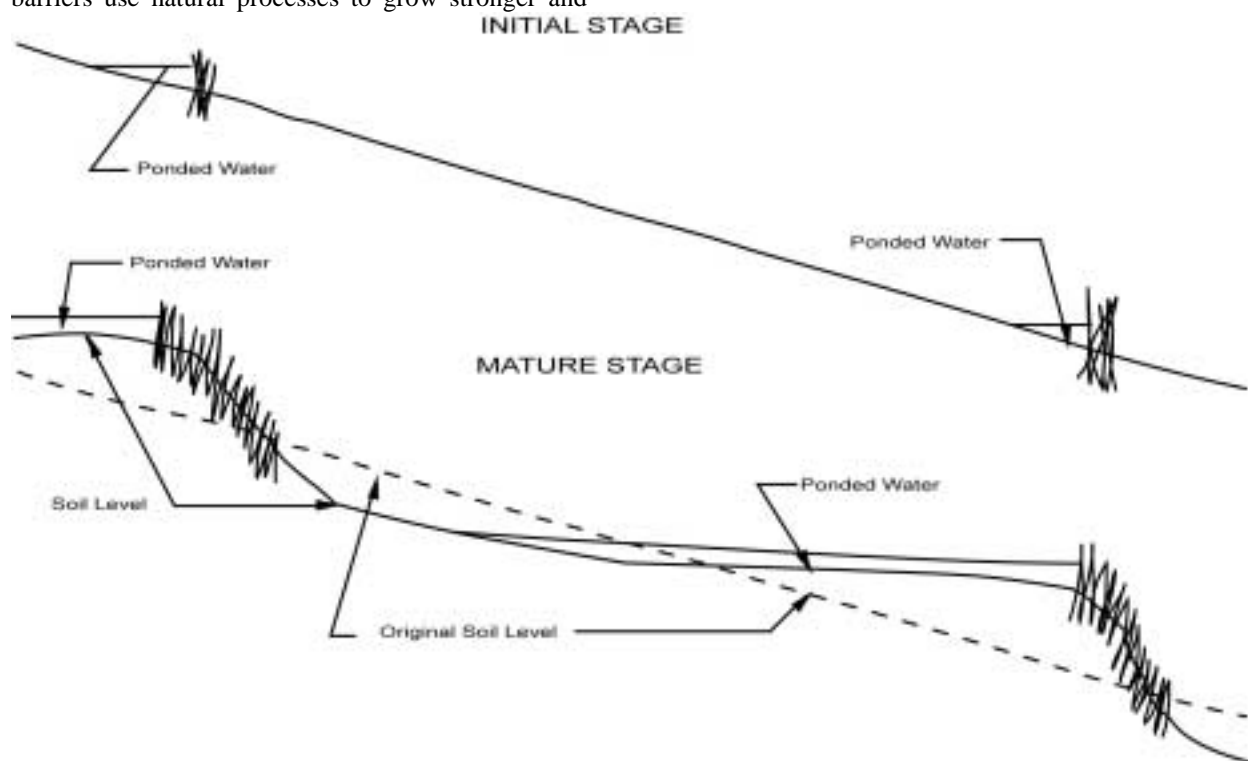
Barriers do not filter sediment; rather they trap sediment upslope of the grass hedge by the process of deposition. Generally, the barrier is unable to filter out sediments because of the relatively large flow spaces between the grass stems. Sediment trapping efficiency is a function of ponded depth (hedge density and flow rate), backwater length (slope), flow rate, and sediment size and density (Dabney et al., 1995).

During small plot studies, slopes not experiencing concentrated flow trapped two-thirds of the sediment. On slopes experiencing concentrated flows, the length of the ponded area as determined by slope was the primary influence on sediment trapping efficiency (McGregor and Dabney, 1993; Dabney et al., 1993). Studies by Meyer (1995) reported a sediment trapping efficiency of 90 percent for particles larger than 125 p.m. and 20 percent for particles smaller than 32 p.m. and a decrease in sediment trapping effectiveness with increasing flow rates for in-between sediment sizes. Overall, trapping of fine

sediments significantly increased as water flows were dispersed and ponded, which also increases potential sediment settling areas (Dabney et al., 1995; Dabney et al., 1996).

The primary long-term benefit is that vegetative barriers use natural processes to grow stronger and

more stable with time, rather than weaker and more vulnerable as do most other erosion control techniques. Over time, the barrier grasses grow up through the sediments deposited upslope of the hedgerow and create permanent bioterraces that may persist on the landscape for centuries (Figure A-1).



**Figure A-1. Profile of a Vegetative Barrier at the Initial and Mature Stage** (Kemper et al., 1992)

Implementation relies heavily on the combination of basic engineering requirements and field observations. Adjustments can be readily made to accommodate prevalent site conditions.

### 1.3.2 Application Specifications

The selected barrier species are switchgrass and eastern gamagrass. The target is to establishment a functional vegetative barrier within one year.

#### Vegetative Propagation

1. Use a walk-behind trencher to produce a 6 inch by 6 inch planting trench along the contour for slope plantings and across the channel for in-channel plantings.
2. Recondition the trench soil based on soil testing by adding lime as necessary to a target pH of 5.5 and incorporate mature compost (EC-2D) or bio-organic fertilizer (EC-2E) as the primary
3. Plant bare root clumps 3 to 6 inches apart, backfill the trench, and firm up the soil. Take care not to bend the roots upward during planting. Planting the slips too far apart renders the system almost useless. Although single tillers can be used to create a barrier, this practice is not recommended because it normally takes too long for the hedge to form.
4. Plant the slips at the beginning of the wet season to ensure that they get full benefit of the rains. Otherwise, irrigate the plantings until established.
5. Special considerations are made for all in-channel plantings and slope barriers subjected to concentrated water flows. Two to three rows are planted as described above and spaced 12 to

16 inches apart. Straw rolls (RC-2B) are placed on the downstream side of the rows to prevent plant dislodging and promote water conservation for the seedlings.

### Seeding

1. Prior to seeding, prepare a seedbed.
2. Recondition the soil within the seeding area based on soil testing by adding lime as necessary to a target pH of 5.5 and incorporating soil amendments as specified above in step 2.
3. If the seedbed is amended with conventional fertilizer, add 0-24-24 at a rate comparable to 100 pounds per acre. Nitrogen is not applied at planting. Native grasses used to establish vegetative barriers have relatively low nutrient requirements and nitrogen promotes weed growth and competition from nonnative species.
4. The minimum vegetative barrier width is 2 feet and the maximum is 5 feet. Plant stratified switchgrass or eastern gamagrass in rows 6 to 8 inches apart. Switchgrass and eastern gamagrass are planted at 10 pounds PLS per acre. Switchgrass is planted to a depth of 0.5 to 0.75 inches, whereas eastern gamagrass is planted to a depth of 1 to 1.5 inches. Planting shallower than that could provide less favorable moisture - seed relations and emergence could be delayed.
5. Switchgrass and eastern gamagrass should be planted in the spring when soil temperatures stabilize in the range of 65 to 80 F (April to June) at a depth of 1 inch. Faster germination and seedling emergence will occur when soil temperatures are near the upper limits of the temperature range (80 to 85 F) when soil moisture is not limiting.

### 1.3.3 Inspection and Maintenance

Gaps will be created in the barrier by slips dying and/or washouts. It is important that the gaps be filled as soon as possible. Replacement propagules can be obtained from established barrier plants by splitting off portions of crown material with a shovel and replanting the crown material in the voids. For seeded hedges, reseed by hand broadcasting and covering the seed by a hand rake.

Once established, the only required maintenance of the hedges is annual trimming to a height of about 12 to 20 inches to encourage grass tillering and control tall weeds. Do not cut the hedge grasses less than 12 inches, otherwise the barrier functions of the

hedge will be compromised and low cutting during active growth periods may severely reduce grass vigor.

## 1.4 ROAD OBLITERATION AND CONSTRUCTION

This section describes the proposed obliteration of a test area road parallel to Oakie Creek and RR 380 and construction of a road to restore access to inert bombing target TT-6.

### 1.4.1 Introduction

Roads, while an indispensable component of the Eglin landscape, have been shown to be a direct source of ecosystem degradation and continually depleting reservoir of economic resources and expenditures. Eglin roads provide an infrastructure required for the performance of military missions and related activities while facilitating deforestation and alteration of habitats. Adverse impacts to the environment are frequently a direct result of the constructed roadway, but impacts may also be associated not with the road, but with the land use changes the road made possible.

Roads are much longer than they are wide, which creates abundant interfaces with the landscapes they traverse. It is the road type, density, location, orientation, and maintenance activities, which constitute the character in which roads transverse the landscape, that determine environmental and economic impact potentials.

Of particular importance to this discussion, are the documented impacts of unpaved roads in relation to TA C-62 stream crossing and stream slopes. All roads are not created equal and do not behave exactly the same. Roads may differ dramatically in their layout on the terrain, method of construction, history of use, and development over time, which corresponds directly to their performance and impact potentials.

### 1.4.2 Road Obliteration

Road obliteration involves removing a road with no plans for future road maintenance or reconstruction. The most effective obliteration restores the original landform to the greatest possible extent. Stream crossings are removed and slopes are recontoured; road surfaces and fill sites are ripped to improve subsurface water flow; and the disturbed roadway is revegetated with native species to restore the ecosystem in a manner that directs succession towards a desired vegetative condition. If implemented

appropriately, obliteration is the most effective approach to road removal since it addresses both terrestrial and water quality impacts. However, obliteration is also the most expensive closure option.

It is recommended that individual obliteration project plans be developed for the Oakie Creek Ridge Road and Range Road 380 discussed below.

### **Oakie Creek Ridge Road**

The approximately 4,664.8 foot test target TT-6 and TT-4 access road that parallels the southern portion of Oakie Creek is a primary contributor to the erosion problems experienced by EIA-2. The road is located on the crest edge of the Oakie Creek stream slope (Figure A-2). This road functions as a water channel that concentrates watershed runoff that has formed extensive gullies along the stream slope (Figures 3-39 through 3-40).

The proposed corrective action includes obliteration of the problematic target access Oakie Creek ridge road and construction of a 610 foot new road in a less impactful location to provide continued access to target TT-6. An alternative access road for TT-4 already exists (Figure A-2). A general road obliteration prescription is presented in Table A-3. Additional information is provided in Chapter 4, Road Decommissioning of the *Eglin Air Force Range Road Maintenance Handbook* at the following website <https://em.eglin.af.mil/road/bmp/>.

### **Range Road 380**

The approximately 5,330 feet of RR 380 road approaches and stream crossing have been identified as a primary source of stream sedimentation and degradation of baygall wetland and terrestrial habitats. Unabated soil erosion has denuded adjacent hillslopes and transported road fill material directly into the receiving stream (Figures 3-41 and 3-42).

The purpose of the road is to provide access to the TA C-62 scoring tower on the western portion of the test area (Figure 2-1). Examination of the area identified an existing alternative route for accessing the scoring tower, allowing the obliteration of this problematic road segment and restoration of the damaged landscape without compromising access to the tower. From the TA C-62 control building, travel north along RR 210, east on RR 203, and south along RR 333 to reach the western tower.

A general road obliteration prescription is presented in Table A-3. Road obliteration BMPs are discussed

in detail in the *Eglin Air Force Range Road Maintenance Handbook* (U.S. Air Force, 2001).

### **1.4.3 New Road Construction**

The proposed 610 foot unpaved sand road is to be constructed in the location shown in Figure A-2. Since trafficking is expected to be light and infrequent, the road can be constructed to a shoulder-to-shoulder width of 14 feet with a 3 to 4 inch roadway surface fill depth. Specifications for the proposed new road construction are as follows.

- Survey the site prior to construction and develop engineering plans with appropriate dimensions and road construction cuts and fills.
- Complete roadside ditches before placing aggregate courses.
- Shape the subgrade to a smooth surface and to the design cross section.
- Apply base and surface coarse materials that are free of excess moisture, muck, lumps, roots, sod, and other deleterious material. Mixtures of sand, clay, and aggregate increase overall material cohesion.
- Finish the road surface to be reasonably smooth, uniform, and shaped to conform to the design surface shape.
- Remove unstable material from the roadbed and replace it with suitable material.
- Ensure that the subgrade is visibly moist during shaping and dressing. Bring low sections, holes, cracks, or depressions to grade with suitable material. Compact the subgrade and finish the roadbed using a vibratory steel-wheel roller or a rubber tired traffic roller.
- Vibratory steel-wheel rollers shall have a minimum weight of five tons. The compactor shall be equipped with amplitude and frequency controls, and specifically designed to compact the material on which it is used.
- Pneumatic tire rollers shall have smooth tread tires of equal size that will provide uniform compacting pressure for the full width of the roller and capable of exerting ground pressure of at least 550 kilo pascals (kPA).

Following application of the base and/or surface, coarse compact the roadbed using a vibratory steel-wheel roller or a rubber tired traffic roller. Roll the roadbed a minimum of five full-width passes or until visual displacement ceases.

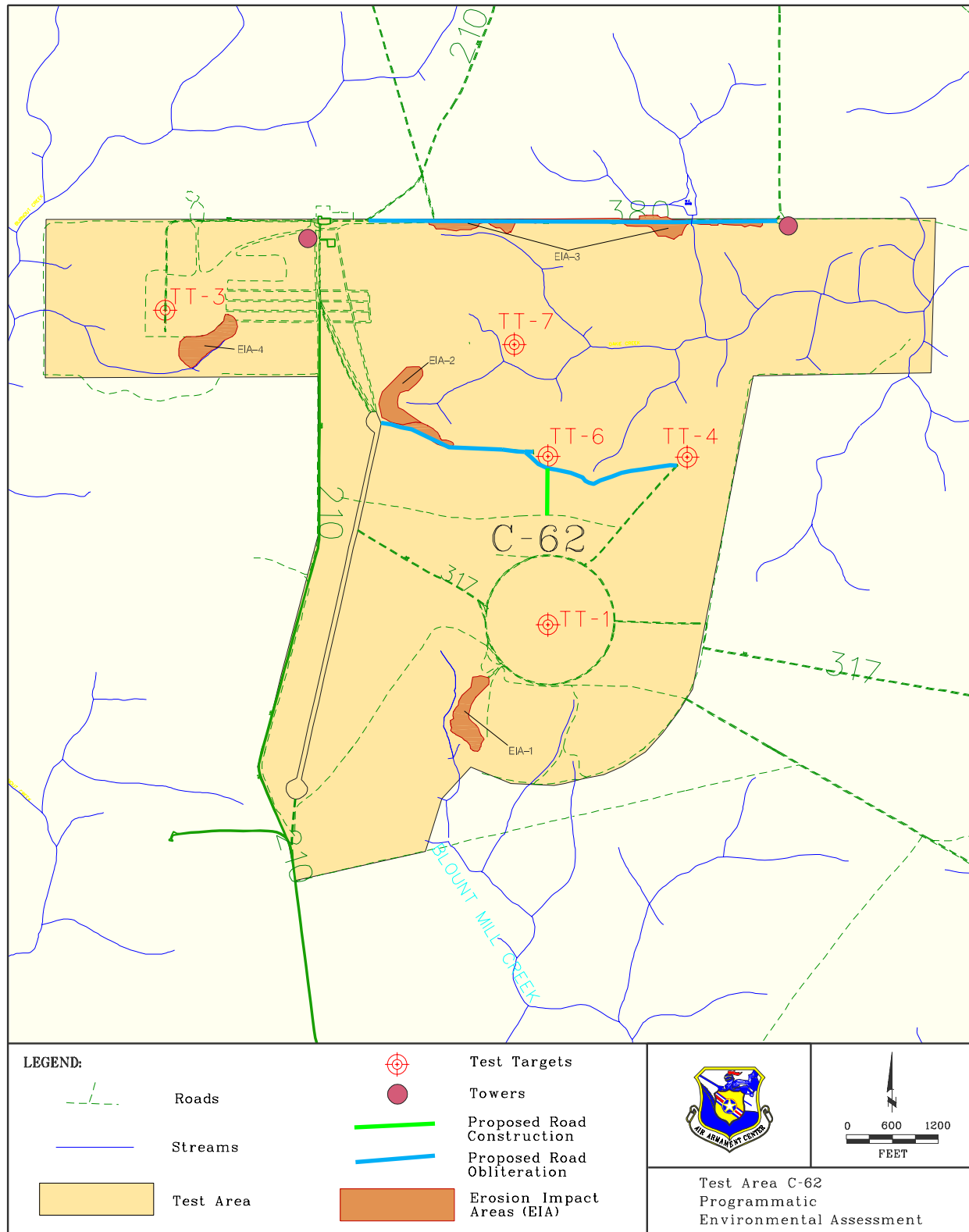


Figure A-2. Proposed Oakie Creek Ridge Road and Range Road 380 Road Obliteration

**Table A-3. Oakie Creek Ridge Road and Range Road 380 Obliteration Prescription**

<b><i>Treatment Strategy</i></b>	<p>The decommissioning of roads through sloped areas entails the application of BMPs that:</p> <ul style="list-style-type: none"> <li>• Control vehicle access</li> <li>• Stabilize slope gradients</li> <li>• Recondition soils</li> <li>• Revegetate all disturbed areas with permanent vegetation</li> <li>• Reestablish natural drainage patterns to the degree possible</li> </ul>
<b><i>Planning</i></b>	<p>Perform a site investigation of the proposed treatment area. Identify the land area that is contributing runoff to the treatment site, and record the soil type(s), landuse, type of cover, and man-made features such as buildings or debris. Use maps and knowledge of the site acquired during field investigations to locate and characterize natural drainage features. Record evidence of seepage flows along slope profiles. Photograph all the relevant features of the treatment slope and the surrounding area including existing cover and drainage patterns. Identify potential locations and construction requirements for reconnecting natural drainage features. Determine if sensitive species and cultural resources are within the realm of influence. Contact utilities to determine the location(s) of underground features before disturbing the surface with heavy equipment.</p>
<b><i>Access Control</i></b>	<p>Install a gate at the road access point(s) to restrict traffic during construction. The gate allows continued access to the area by construction personnel and equipment while restricting unauthorized road use. After the completion of all other road obliteration activities, install a temporary post and cable barrier. Once vegetation is well established, the barrier can be removed and stored for reuse.</p>
<b><i>Roadside Fill Materials</i></b>	<p>Locate earthen features such as road fill windrows and historic roadside soil berms and mounds that are to be removed. Concrete blocks and other debris are to be transported off the site and disposed of at an appropriate facility. If possible, transport the removed soil to other portions of the road that require fill. Clearly mark the boundaries of areas to be filled. Ensure that all fill material is properly compacted and vegetated. Avoid the introduction of fill materials to wetland areas</p>
<b><i>Slope Stability</i></b>	<p>Construct stable side slopes and minimize the disturbance of other areas to the degree possible. Remove and store topsoil of undisturbed areas that will be incorporated into the slope for use during final seedbed preparation. Salvage and store on-site topsoil reserves affected by construction activities for use in reconditioning soils. After construction is complete, perform a construction check survey and verify that slope gradient is within tolerances while equipment and operators are on-site, preferably during the construction process.</p>
<b><i>Runoff Control</i></b>	<p>Based on design flow velocities, vegetative barriers are established on sensitive slopes. Reestablish crossroad native drainage patterns to the degree possible. Avoid the construction of diversion berms to encourage the reconstitution of natural drainage patterns.</p>
<b><i>Soil Reconditioning</i></b>	<p>Based on soil test result, apply and incorporate lime and compost during ground preparation. Based on the extent of road prism soil compaction measured with a penetrometer, a soil ripper or subsoiler is used to decompact the roadbed and other disturbed areas. Following ripping, prepare the seedbed for planting by lightly disking or chisel plowing. Based on soil test results, apply and incorporate bio-organic fertilizer and mycorrhize soil amendments during final seedbed preparation. No soil amendments are applied to portions of the road prism that are to be buried by fill materials. Soil amendments may be added following application of fill materials.</p>
<b><i>Revegetation</i></b>	<p>All disturbed slope surfaces will be revegetated as soon as possible after roadway ripping and recontouring. The road prism and other disturbed areas are to be planted to native grasses, forbs, vines, shrubs, and/or trees. Based on a determination of dominant soil moisture conditions, the area is planted to a droughty, dry, or wet soil plant mix (Table A-1). If the spring to mid-summer window for planting and establishing permanent vegetation has passed, plant the area to temporary vegetative cover of cool-season, annual small grains such as oats. Based on site conditions and type vegetation, apply mulching materials as required. Compost mulch is a preferred mulching material for most circumstances. Erosion control blankets may be seeded before or after mat installation. For slopes and channels that will experience concentrated water flows, plant vegetation before mat installation. Several commercial vendors of erosion control blankets and turf reinforcement mats are available. Closely monitor plant development and implement irrigation as needed. If plant density falls below criteria, the area may need to be reseeded.</p>



## 2. INTEGRATED VEGETATION MANAGEMENT

This section describes proposed TA C-62 Integrated Vegetation Management Program grassland/shrubland hexazinone herbicide application and prescribed burning BMPs and a general review of the characteristics of hexazinone and its behavior in the environment. A detailed analysis of hexazinone application to Eglin test areas can be found in *Biological Assessment to Determine Potential Impacts to Federally-Listed Endangered Species Resulting from the Application of the Forest Herbicide Hexazinone on Eglin's Land Test Areas* (U.S. Air Force, 2000b) and *Biological Assessment to Determine Impact to Federally-Listed Species Resulting from Current and Proposed Test Area Maintenance Programs* (U.S. Air Force, 2000c). Hexazinone may not be applied to TA C-62 until stable slopes and vegetative communities are established on Erosion Impact Areas 1, 2, 3, and 4. Otherwise, there is a high risk of hexazinone contamination of test area streams and wetlands.

### 2.1 INTRODUCTION

Integrated vegetation management is based on the elimination of TA C-62 roller drum chopping and the combination of chemical herbicide and prescribed burning practices to manage woody vegetation in a cost effective, environmentally responsible manner reducing potential impacts to sensitive species and improving water quality. The herbicide hexazinone (Velpar ULW) would be initially applied to the test area to remove woody species followed by a prescribed burning to provide long-term maintenance of preferred native grassland communities. Elimination of roller drum chopping would increase the growth and density of grasses and forbs, providing increased fuel loads capable of sustaining beneficial fires.

### 2.2 HEXAZINONE HERBICIDE APPLICATION

The section provides a description of hexazinone application procedures developed for TA C-62 and a review of the literature concerning hexazinone characteristics and behaviors in the environment.

#### 2.2.1 Hexazinone Application Procedures

In order to maximize the effectiveness of the integrated vegetation management program and minimize potential environmental impacts, test area hexazinone herbicide application procedures were developed. These procedures were crafted from a review of the literature, assessment of test area mission requirements, analysis of the character of Eglin's natural resources, and consideration for potential sensitivities of Eglin's federally listed species.

The procedures provide mitigations for identified natural resource impact sensitivities. Mitigations may include any supplemental activities designed,

proposed, and exercised to help reduce or eliminate potential impacts to the environment. The proposed Integrated Vegetation Management Program procedures and mitigation issues are presented in Table A-4.

The initial application of Velpar ULW that proceeds prescribed burning will provide the needed die back of most woody species. Of the woody vegetation on the test area, yaupon and persimmon are likely to be most resistant to Velpar applications. The capability of prescribed burning to control outbreaks of these and other species is dependent on frequent test area burns that result in repeated top-kill of resprouted individuals.

It is important to note that the complete restoration of EIA-1 through EIA-4 is required before hexazinone can be applied to TA C-62.

#### 2.2.2 Hexazinone: A Literature Review

Properly applied, there are no known adverse impacts to sensitive species associated with Velpar ULW. This section provides a general review of the chemical characteristics of hexazinone and its behavior in the environment. .

##### Description

Hexazinone (3-cyclohexyl-6-dimethylamino-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione) is a white, crystalline solid having a molecular weight of 252.3, specific gravity of 1.25, and melting point of 115 to 117 Celsius. Hexazinone is a general use pesticide and triazine herbicide used against annual, biennial, and perennial broadleaf weeds, and woody plants. Except for Johnsongrass, it is effective for the control of most perennial weeds. Application methods include aerial broadcast, basal soil treatment, undiluted spot treatment or woody stem injection. Other triazine herbicides include atrazine, simazine, cyanazine, prometon, and metribuzin.

**Table A-4. TA C-62 Integrated Vegetation Management Procedures**

<b>Procedure</b>	<b>Procedure Directive</b>	<b>Mitigation Issues</b>
<b>Hexazinone Formulation and Application Rate</b>	<p>Hexazinone will be applied as Velpar ULW pellets at the rate of 2 to 4 pounds of active ingredient per acre. Two pounds per acre will be applied to test areas dominated by scrub oaks and 3.5 to 4 pounds will be applied to yaupon and/or persimmon infested areas.</p> <p>Velpar ULW pellets are applied to the TA C-62 treatment area (Figure A-3) during the months of March and/or April to control woody vegetation. The treatment area boundary will be field verified as adequate for preventing exposure of Velpar to streams and wetlands prior to field application.</p> <p>Liquid Velpar L will not be used on TA C-62.</p>	<p>Hexazinone will tend to be mobile within the soil profile and susceptible to transport by surface runoff and subsurface leaching. Hexazinone is highly soluble and Lakeland sand hydrologic conductivity typically ranges from 20 to 28 inches per hour.</p> <p>Generally low levels of surface litter and soil organic matter and clayey materials typical of test area Lakeland sands reduce the capacity of the soils to immobilize hexazinone.</p>
<b>Hexazinone Application Methods</b>	<p>Velpar ULW is applied by aircraft, vehicle, and/or individuals as deemed appropriate by logistics, treatment method, economics, and/or safety constraints. Low impact application methods using vehicles or individuals are employed to delineate treatment exclusion areas and for spot treatment.</p>	<p>Program implementation is partly dependent on economic feasibility. Treatment of unexploded ordnance area will require aerial application.</p>
<b>Treatment Exclusion Areas</b>	<p>Under no circumstances is Velpar ULW to be applied directly to treatment exclusion areas (designated sensitive area and buffer zone) including:</p> <ul style="list-style-type: none"> <li>• Surface waters – intermittent and perennial streams, rivers, lakes, ponds, steepheads, and wetlands</li> <li>• Stream and river riparian zones</li> <li>• Known location of state and federal listed plants deemed susceptible to hexazinone treatment</li> </ul> <p>Treatment exclusion areas will be delineated prior to treatment to avoid accidental application. The TA C-62 Velpar ULW treatment area is defined in Figure A-3.</p>	<p>Direct application of hexazinone on sensitive species and/or habitats could result in species toxicity, habitat alteration, and/or life cycle interference.</p> <p>Under saturated soil conditions, there is a potential significant lateral down gradient movement of hexazinone on 2 percent and greater slopes, whereas under unsaturated conditions, water moves relatively slowly through the upper soil profile and may be retarded by confining layers regardless of slope.</p>

**Table A-4. TA C-62 Integrated Vegetation Management Procedures Cont'd**

<b>Procedure</b>	<b>Procedure Directive</b>	<b>Mitigation Issues</b>
<b>Buffer Zones</b>	<p>Hexazinone treatment exclusion buffer zones are delineated by mechanical and/or individual applications of Velpar ULW to provide a visual dieback marker of test area herbicide application boundaries. A buffer zone is defined as a transition between two different land uses to protect one from the changes in the other (Brown and Schaefer, 1987). Site-specific drainage features associated with the treatment exclusion area determine the width of buffer zones.</p> <p>Buffer zone delineation is governed by the estimated susceptibility of contiguous slopes, road conducts, and/or natural drains associated with the treatment exclusion area to transport Velpar ULW pellets by stormwater runoff.</p> <p>Generally, adjacent areas with contiguous slopes greater than 5 percent and/or vegetative cover of less than 50 percent are considered to have a high herbicide transport capability and would be delineated as a part of the buffer zone. The minimum width of a buffer zone is 250 feet.</p> <p>For test area roads running perpendicular to stream slopes or along the ridge crest of the stream slope, an additional buffer area with a minimum width of 100 feet will be applied to reduce the potential for hexazinone transport in runoff.</p>	<p>Pelleted Velpar UWL is susceptible to suspension and transport along natural drainage corridors by stormwater runoff to receiving aquatic resources.</p> <p>The nutrient- and organic carbon-limited Lakeland sands could limit the metabolic activity energy sources for the sustained growth and persistence of diverse microbial populations adapted to hexazinone degradation.</p> <p>Hexazinone will have a hydrolysis half-life in soil and groundwater greater than 30 days and half-life of less than 50 days in plant tissue.</p> <p>Hexazinone applied to sandy Lakeland soils of TA C-62 could undergo less than optimum soil microbial degradation; leach soluble residues to groundwater following storm events; and undergo plant uptake, dilution, photodegradation, and biodegradation in receiving ecosystems.</p>
<b>Hexazinone Spot Treatment</b>	<p>Prescribed burning will be used as a primary tool for long-term management of grassland type ecosystems with Velpar UWL applications only being employed to spot treat areas of heavy infestations and to manage invasion by woody exotics.</p>	<p>Aggressive woody species may persist after initial treatment with Velpar UWL, and woody exotics may invade the site.</p>

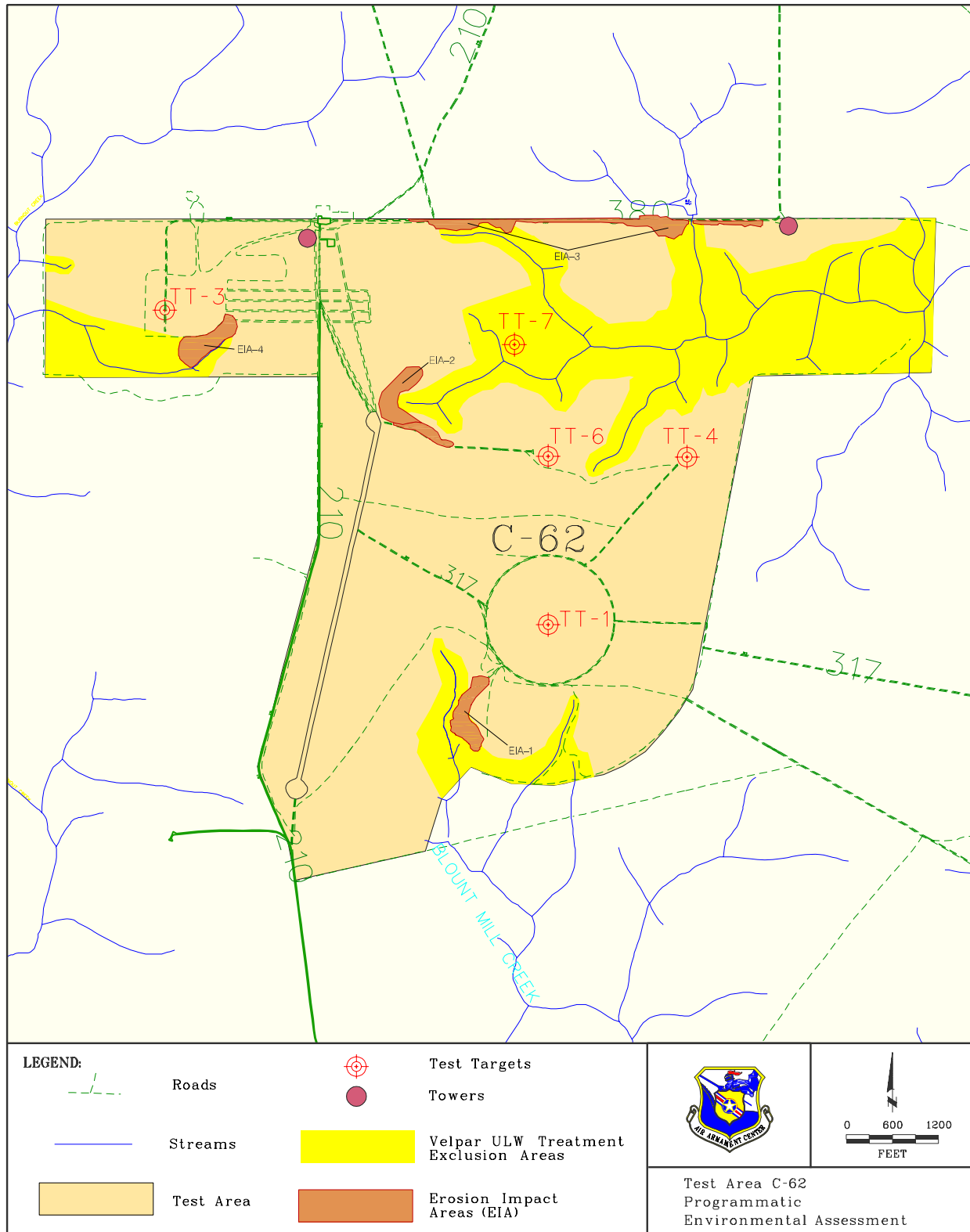


Figure A-3. Proposed TA C-62 Velpar ULW Treatment Area

Hexazinone may be used as preplant incorporated, preemergence, and (to a limited extent) early postemergence for selective control of weeds and annuals and established perennial crops and forestry and rangeland vegetation management. Commercial formulations of hexazinone include:

- Velpar® (water soluble powder): Hexazinone (90%) and inerts (10%)
- Velpar® ULW (soluble granules): Hexazinone (75%) and inerts (25%)
- Velpar® L (water-dispersible liquid): Hexazinone (25%), ethanol (40 to 45%) and inerts (30 to 35%)
- Pronone® 10G (granules): Hexazinone (10%) and inerts (90%)

The inert ingredients contained in Velpar and Pronone formulations are not classified by the U.S. Environmental Protection Agency as inert ingredients of toxicological concern to humans or the environment (Dupont, 1995). Hexazinone is water soluble and not lipid soluble, which means it cannot cross cell membranes in animals but can cross cell walls in plants.

Hexazinone is a systemic herbicide that is translocated only apoplastically (capable of only upward movement) and works primarily as a photosynthetic inhibitor. The herbicide is readily absorbed through the roots and/or leaves – depending on the type of formulation and method of application – and moves upward through the xylem with the plant transpiration stream. Hexazinone has a high degree of contact activity, which can be enhanced by the addition of a nonionic surfactant.

Control of established perennials requires soil uptake with foliar applications alone only providing shoot kill. Soil uptake results in symptoms development from the bottom to the top of the plant shoots with chlorosis first appearing between leaf veins and along the margins, which is followed by necrosis of the tissue. Rainfall or irrigation is required before it becomes active.

Hexazinone has not been reported to be associated with any human death or hospitalized case since 1976. The voluntary accident reporting system reported one accidental ingestion (Food and Drug Administration, 1986).

## Toxicology

The toxicity of a chemical is a measure of its ability to harm organisms. Harm may come in the form of interference with biochemical processes, interruption of enzyme function, and/or organ damage. Ecotoxicological categories and toxicity ranges as defined by the U.S. Environmental Protection Agency (EPA) (1988) are presented in Table A-5.

Probably the best known expression of toxicity is the LD<sub>50</sub> and LC<sub>50</sub> dose and concentration that is lethal to 50% of the test population. No hexazinone toxicity data was available for the red-cockaded woodpecker and Okaloosa darter. For comparative analysis, Velpar ULW toxicity data for the bobwhite quail and fathead minnow are presented (Table A-6).

Based on the data presented in Table A-6, Velpar ULW is considered practically nontoxic to the bobwhite quail, bluegill sunfish, rainbow trout, daphnia magna, and fathead minnow.

Hexazinone has been identified as a severe eye irritant causing irreversible corneal opacity and corrosion damage. The U.S. Environmental Protection Agency has classified hexazinone as a Class D pesticidal chemical (not classifiable as to human carcinogenicity) (Dupont, 1995).

## Environmental Fate and Transport

Following hexazinone application, the chemical immediately begins to interact with the biological, physical, and chemical constituents of the environment. Hexazinone is dependent on water for activation. The persistence or length of time hexazinone remains active in the soil environment is primarily governed by the interaction of soil chemical, physical, and microbial features, climatic conditions, and the chemical properties of the herbicide. The movement of hexazinone through water, soil, and plant matrices and its ultimate disappearance is governed by the water cycle, which constitutes evapotranspiration, runoff, leaching, plant uptake, metabolism, hydrolysis, and in some cases photolysis.

A summary of the literature pertaining to hexazinone environmental fate and transport is presented in Table A-7.

**Table A-5. Ecotoxicological Categories<sup>a</sup>**

Category	Mammalian (Acute oral) <sup>b</sup> mg/kg	Avian (Acute oral) <sup>b</sup> mg/kg	Avian (Dietary) <sup>c</sup> ppm	Aquatic Organisms <sup>d</sup> ppm
Very highly toxic	<10	<10	<50	<0.1
Highly toxic	10-50	10-50	50-500	0.1-1
Moderately toxic	51-500	51-500	501-1,000	>1-10
Slightly toxic	501-2,000	501-2,000	1,000-5,000	>10-100
Practically non-toxic	>2,000	>2,000	>5,000	>100

<sup>a</sup> The higher the number, the lower the acute toxicity.

<sup>b</sup> Dose is dependent on the body weight of test animal.

<sup>c</sup> Concentration in diet is unrelated to body weight of test animal.

<sup>d</sup> Concentration in water is unrelated to body weight of test animal.

**Table A-6. Velpar ULW Wildlife Toxicity**

Species	Toxicity Criteria (mg/kg)*
Bobwhite Quail	
LD <sub>50</sub> (Acute Oral)	2,258
LC <sub>50</sub> (8-Day Dietary)	>5,000
Bluegill Sunfish	
LC <sub>50</sub> (96-Hour)	370 - 420
Rainbow Trout	
LC <sub>50</sub> (96-Hour)	>320
Daphnia Magna	
LC <sub>50</sub> (48-Hour)	151.6
Fathead Minnow	
LC <sub>50</sub> (96-hour)	274

\* Mg/kg of body weight

Source: Dupont, 1995

**Table A-7. Literature Summary of Hexazinone Environmental Fate and Transport**

Mechanisms	Results/Conclusions	Reference
Photodegradation and Volatilization	Laboratory studies identified a degradation rate of 20% in 8 weeks in distilled water under artificial sunlight. Photodegradation rates were approximately 7 times faster in natural river water. When applied to thin soil surfaces, 60% of the <sup>14</sup> C-labeled material (10 ppm) was degraded during a 6-week exposure to UV light. Hexazinone is relatively resistant to decomposition by ultraviolet radiation; however, photodegradation substantially increases when the material is in water.	Weed Science Society of America, 1989
Plant Tissue and Soil Persistence	Hexazinone exhibits a hydrolysis half-life greater than 30 days at pH 5, 7, and 9 at 25°C.	Dupont, 1995
	Hexazinone half-life in field soil studies ranged from less than 3 weeks to 12 months.	Bush et al., 1990
	Half-life in plant tissues normally does not exceed 40 days.	Michael and Neary, 1990
	Reported a half-life of Velpar ULW in sampled plants of 26 to 59 days and 55 to 77 days dissipation in litter and soil. Dissipation to background levels was complete by 365 days in all matrices (foliage, litter, soil, fish, benthic macroinvertebrates, and stream water) except sediment.	Michael et al., 1999
	Under certain conditions, hexazinone may remain in the soil at low concentrations for up to 3 years.	Food and Drug Administration, 1986

**Table A-7. Literature Summary of Hexazinone Environmental Fate and Transport Cont'd**

<b>Mechanisms</b>	<b>Results/Conclusions</b>	<b>Reference</b>
Biodegradation	Greenhouse studies of $^{14}\text{C}$ -labeled hexazinone biodegradation in sandy loam soils showed a half-life of intact $^{14}\text{C}$ at approximately 4 to 5 months. In comparative field studies, the half-life of intact $^{14}\text{C}$ was 1 month in a Keyport silt loam, 2 months in a Flanagan silt loam, and 6 months in a Dundee silt loam.	Weed Science Society of America, 1989
	Studies with $^{14}\text{C}$ -labeled material showed that microbial degradation contributes to decomposition of hexazinone in the soil. Laboratory biometer flask studies of $^{14}\text{C}$ -labeled material applied at 4 ppm and 20 ppm to two soil types, 45% to 75% $^{14}\text{C}$ evolved as $^{14}\text{CO}_2$ after 90-day incubations.	Rhodes et al., 1980
Surface Runoff and Subsurface Flow Mobility	The off-site movement of hexazinone in storm runoff was not considered to be significant. Maximum stream concentrations were observed during application and generally diluted 3 to 5 times within 1.6 kilometers downstream, and in many instances the duration of peak concentrations persisted for less than 15 minutes. Hexazinone was generally not present significantly above the detection limits in water after about 6 months. Dissipation of metabolites generally followed the same, but delayed, pattern of the parent compound. Hexazinone movement in soil was consistently detected to 30 to 45 centimeters, but rarely detected above background level in the range 60 to 75 and 75 to 90 centimeters.	Michael et al., 1999
	Hexazinone applied to four 2.5 acre watersheds at a rate of 1.5 pounds per acre lost 0.53 percent of the herbicide residue to storm runoff. The primary source of residue loss occurred as result of herbicide pellets being applied directly into intermittent stream channels. Subsurface movement was limited to depths of about 6 feet and produced short, low level (less than 20 ppb) pulses of herbicide residue in streams.	USDA Forest Service, 1984
	Hexazinone residues in streamflow can occur at high concentrations (up to 2,400 $\mu\text{g/L}$ ) if pellets are applied directly into perennial streams.	Miller and Brace, 1980
	Reported no residues in streamflow during a 7-month period after aerial herbicide applications that did not over fly streams or stream buffer zones.	Neary, 1983
	Hexazinone adsorption and dilution facilitated by an untreated 100-foot stream buffer strip reduced potential streamflow residues to below detectable levels.	Bush et al., 1995
Metabolism and Bioaccumulation	Animals fed 125 mg/kg of hexazinone for two weeks then given a small single dose, excreted the majority of the hexazinone within three days. Less than 1% of the parent hexazinone was detected in urine and feces. Dairy cows given small amounts of hexazinone in their diets for 30 days had no detectable residues in milk, fat, liver, kidney, or lean muscle but did have minute amounts of a hexazinone metabolite in their milk.	Food and Drug Administration, 1986
	Detected residue levels in invertebrates a maximum of two orders of magnitude greater than comparable levels (0.01 to 0.18 ppm) found in forest floor litter following pelleted hexazinone application at a high rate of 16.8 kg a.i./ha. Macroinvertebrate biological uptake and/or passive accumulation were identified as the possible mechanisms of bioaccumulation. Decreases in the abundance of macroinvertebrates were likely related to vegetation habitat changes rather than herbicide toxicity. Soil microarthropod sampling revealed no major community changes.	Mayack et al., 1982

**Table A-7. Literature Summary of Hexazinone Environmental Fate and Transport Cont'd**

<b>Mechanisms</b>	<b>Results/Conclusions</b>	<b>Reference</b>
Surface Runoff and Subsurface Flow Mobility cont'd	In Arkansas, avoiding the direct application of hexazinone (2.0 kg/ha) to intermittent stream channels resulted in maximum stream concentrations of less than 14 µg/L. Off-site transport of the herbicide amounted to 2% to 3% of the applied parent material.	Bouchard et al., 1985
	A study of four small watersheds in the upper Piedmont of Georgia detected peak hexazinone residue in streamflow (average of 442 µg/L) in the first storm after application of Velpar ULW pellets (1.68 kg/ha) and a decline in concentrations with subsequent storms. Subsurface movement of hexazinone appeared 3 to 4 months after application in stream baseflow at concentrations <24 µg/L.	Neary et al., 1983
	In the South Carolina study, pelleted Pronone was applied (2.8 kg a.i./ha) to a Dothan loamy sand and Fugary sand site. Detectable hexazinone residue (3.6 ppb) was observed in a monitoring well 126 days following Pronone application; all other groundwater samples were non-detectable. In the Florida central highlands study, liquid Velpar L was applied (1.7 g a.i./kg) on a deep Astatula sand, Eustis sand, and Sellers sand. Residues were periodically detected (17 to 35 ppb) in monitoring well samples for 1 year after Velpar L application. After the first rainfall event, hexazinone was detected at 3 ppb in a sinkhole pond. In sandy soils with low organic matter, there is a potential for hexazinone to reach groundwater following heavy rainfall events.	Bush et al. 1990
	Reported that herbicide loss occurred as short duration pulses several days after peak storm events, which suggests that subsurface flow(s) may be a more prominent long-term influence in aquatic ecosystem herbicide residue exposures than surface runoff.	Mayack et al., 1982
	In sandy soils in South Carolina, hexazinone residues were detected in shallow and deep monitoring wells up to 18 months after March and April applications of Velpar L (3 lbs. a.i./acre). Hexazinone residues in upper slope deep and shallow wells peaked 2 months after application at 29.2 ppb and decreased to non-detectable levels within 6 months. Hexazinone was detected in one upslope shallow (4 feet deep) monitoring well one month after the April application at 259 ppb, which exceeds the EPA hexazinone lifetime HAL drinking water exposure criteria. Residues in the down gradient wells peaked at 115 ppb three months after application and persisted at >10 ppb for one year.	Bush et al. 1995

### Biodegradation

Hexazinone parent materials and metabolites are dissipated primarily by biodegradation to lower molecular weight compounds (metabolites) through normal soil microbial processes (Dupont, 1995). Microbial degradation rates tend to decline with increasing depth below the root zone and pesticide degradation within aquifer materials may be very slow or non-existent. Hexazinone biodegradation converts the compound into four primary metabolites by breaking the triazine ring to liberate <sup>4</sup>CO<sub>2</sub>. These metabolites may also be toxic to plants, but are relatively short-lived (Moorman, 1990).

Principal hexazinone degradation by soil microbes is most likely to occur within the region of influence of the plant root rhizosphere during translocation by soil water and plant uptake. The rhizosphere is the soil-root interface, approximately one to two millimeters wide, surrounding the epidermis of living root hairs and the boundary cells and hyphae of mycorrhizae where soil elements are absorbed into the plant (Anderson and Coats, 1994; Darrah, 1993; Walton and Anderson, 1990; Anderson et al., 1990).

### Mobility

Soil adsorption capabilities are related to the properties of the herbicide such as formulation and application rate and properties of the soil such as clay



mineralogy, organic matter and iron oxide content, texture, permeability, pH, particle size, surface area, ion exchange capacity, soil water movement, and temperature. The soil constituents most associated with immobilization of pesticides are clay, iron oxides, and organic matter. Hexazinone has a high solubility of 33,000 mg/L at 25°C, which makes it weakly adsorbed to soils constituents and prone to leaching (Williams et al., 1988).

The application of hexazinone directly into receiving streams or surface water is primarily responsible for most severe stream concentrations. Aside from direct application onto surface waters, the primary routes of aquatic exposure are short distance stormwater runoff and subsurface spring and valley wall seepage flows particularly in sandy soils with high infiltration and hydrologic conductivity. Hexazinone transport into streams primarily occurs during the first two to three storm events with maximum surface water concentrations tending to be associated with peak stream discharge (Miller and Brace, 1980; Mayack et al., 1982; Neary, 1983; Neary et al., 1983; USDA Forest Service, 1984; Bouchard et al., 1985; Bush et al., 1990; Bush et al., 1995). Untreated stream buffer zones have been used effectively to mitigate overland and subsurface water concentration potentials (Michael and Neary, 1990; Bush et al., 1995).

Under saturated soil conditions, there is the potential for lateral down gradient movement of hexazinone on 2 percent and greater slopes, whereas under unsaturated conditions water moves relatively slowly through the upper soil profile and may be retarded by confining layers regardless of slope (Bush et al., 1995).

### Metabolism and Bioaccumulation

Animals rapidly metabolize and eliminate hexazinone from their systems. Studies of hexazinone exposures in aquatic ecosystems have reported no evidence of residue accumulation in aquatic organisms. No impacts to the community structure of invertebrates or fish and no significant shifts in species composition or diversity were noted. The relatively small loss of hexazinone from treated watersheds, subsurface flow, and mainstream dilution were identified as mechanisms that limited aquatic organism exposure to hexazinone to intermittent, short duration, low-level concentrations. In contrast to studies of aquatic organisms, hexazinone has been shown to accumulate in terrestrial organisms (Mayack et al., 1982; USDA Forest Service, 1984; Webber, et al., 1991; Michael et al., 1999).

### 2.3. GRASSLAND/SHRUBLAND PRESCRIBED BURNING

Prescribed burning is the intentional application of fire to wildland fuels – in either their natural or modified state – under specified environmental conditions. The purpose of prescribed burning test area lands is to promote the establishment and growth of native grasses and control woody vegetation; the intent is to control woody vegetation and not to eradicate it from the test areas. Because of the vigorous sprouting and fruit production capabilities of many woody species, eradication is not a realistic goal.

In grasslands, prescribed fire can increase grass nutritive quality, palatability, availability, and yield, reduce hazardous fuels, suppress unwanted plants, and improve wildlife habitat. Grass quality and availability are improved because the fire removes dead plant material and improves access to new growth. If soil moisture is adequate, grass yields increase because baring and darkening the soil surface allows it to warm more quickly and stimulate earlier growth, and because competing plants are suppressed.

Control of the growth and density of most woody vegetation can be managed with fire while increasing the growth and production of native grasses such as big bluestem (*Andropogon gerardii* var. *gerardii*), little bluestem (*Schizachyrium soparium*), Indiangrass (*Sorghastrum nutans*), and switchgrass. Fall and early spring burns decrease big bluestem, Indiangrass, and switchgrass. Late spring burns increase big bluestem and switchgrass and increase or maintain Indiangrass. Little bluestem generally reacts inconsistently and is unpredictable.

Woody vegetation is most effectively controlled by late spring burning. In the absence of burning there is normally a decrease in these and other warm season native grasses and an increase in woody vegetation. Briggs (1992) found that without burning and with adequate moisture, the number of trees increased over a five-year period by 60 percent, while in an area annually burned the number of trees decreased.

Woody species such as yaupon (*Ilex vomitoria*), persimmon (*Diospyros virginiana*), bluejack oak (*Quercus incana*), and turkey oak (*Quercus laevis*) are primary problematic weed species that are the target of test area burning. Yaupon can be top-killed by mild fires and presumably survives fire by sprouting from the root crown. Common persimmon is well adapted to fire and readily sprout from roots

and root crown when above ground portions are top-killed. Bluejack and turkey oaks are top-killed by low severity fire and respond by sprouting vigorously from the root collar. These oaks can recover from repeated top-kill because sprouting individuals may have more than 85 percent of their biomass underground.

For test areas exhibiting infestations of yaupon and/or persimmon that were not killed by hexazinone applications, burns would be performed for two to three consecutive years. Otherwise, the test areas are burned on a three-year rotation. Burning can be performed on a four or five year rotation if no problems exist. Firebreaks will be maintained at the woodline/test area boundary to keep test area fires on the test area.

Burning during the wrong environmental conditions is dangerous and can harm desirable plants. Plant growth may be reduced if soil moisture is low at the time of the fire. When soil moisture is low, the risk of soil erosion increases because ground cover is removed and plant regrowth is delayed.

Burning when relative humidity is less than 25 percent, air temperature is above 80°F, and wind

speed is more than 15 mph causes intense, possibly dangerous fire behavior. On sites with low fine-fuel loads, humidity higher than 60 percent, temperatures less than 40° F, and winds less than 5 mph will result in patchy, incomplete burns that may fail to achieve management objectives. In most cases, fires should not be set unless winds are at least 5 mph from a consistent direction. This allows the fire to be controlled and directed. Light and variable winds will cause the fire's direction to shift erratically, making control difficult.

Improper fire timing can reduce plant productivity. If the goal is to increase warm-season tallgrass growth, the burn should be just before or during growth initiation, in early spring. Yields will be reduced if these grasses are burned when actively growing. If the burn is too early, cool-season grasses will increase and deplete soil water and nutrients before warm-season grasses begin growth.

Consult with the Eglin Air Force Base Natural Resources Branch, Jackson Guard, Fire Management Section before planning test area grassland/shrubland prescribed burns.

### 3. WETLAND MANAGEMENT

This section describes TA C-62 seepage slope bog and stream baygall wetland management activities. Proposed BMPs include extent of disturbance boundary markers for sensitive wetland areas and wetland prescribed burning. Special attention is directed towards the sensitive seepage slope bog located along the western headwater stream segment of Blount Mill Creek.

#### 3.1 INTRODUCTION

Biological analysis of the stream seepage slope bog and baygall wetlands that occur on TA C-62 identified wetland ecosystems heavily impacted by erosion and sedimentation and absence of natural fire events. It was determined that these wetlands perform valued habitat and water quality functions important to the overall sustainability of the test area.

The habitat and water quality functions of TA C-62 have been well documented in Chapters 3 and 4 of this Programmatic Environmental Assessment. Since test area wetlands are directly linked to surface water and groundwater flows, it is reasonable to assume that sediments and many chemical residues produced by test area mission activities are destined to move into streams that pass through wetlands.

As discussed in Chapter 4, it is important to the maintenance of wetland habitat and water quality functions that consideration be extended to the protection and fire maintenance of wetland ecosystems with an overall goal of no net loss of wetland functions. Reaching this goal requires that mission impacts must be compensated for in a manner that stimulates the management and enhancement of wetland functions.

#### 3.2 EXTEND OF DISTURBANCE BOUNDARY MARKERS

The moist to saturated nature of wetland soils makes them susceptible to damage from wheeled and intensive foot trafficking. Damage is primarily manifested in the form of disturbed plant root mass and alteration of surface and/or subsurface wetland hydrology.

Although no wheeled traffic soil damage has been identified on TA C-62 wetlands, the increased focus of active management of the test area resources could present a risk of damage to wetland soils. The area of particular concern is the seepage slope bog located on the slopes of the western headwater segment of Blount Mill Creek. Other baygall wetlands along Oakie and Burnout Creek may also require protection.

The bog is in close proximity to the CE-EOD OB/OD unit. Activities associated with OD debris recovery, EIA-1 stream slope restoration, and other potential land based missions may warrant the establishment of a restricted access buffer area around the bog to prevent unwanted trafficking.

It is proposed that permanent markers be established no less than 150 feet from the perimeter of the bog or other wetland area to signify the allowable extent of disturbance and trafficking. The markers could be spaced 300 feet apart and display a sign stating limits to surface disturbance and trafficking.

#### 3.3 WETLAND PRESCRIBED BURNING

Generally, wetlands will carry fire as well as uplands under moderately dry conditions; in some instances fuel loads may be considerably higher per unit area in wetlands than in uplands, creating the potential for much hotter and faster burns. Burning wetlands can be especially effective in wetland communities in which a diversity of native species is still present.

A correctly timed fire provides a disturbance that that can disrupt the life cycle of some exotic grasses while promoting the growth of native grasses. The literature generally supports the contention that native grass and forb diversity is increased following burns (Kirby et al., 1988).

The primary goal of wetland burning on TA C-62 is to control woody shrub encroachment and promote a natural balance in native vegetation endemic to fire maintained wetlands. The succession of portions of TA C-62 seepage slope and baygall wetlands towards shrub monocultures would alter hydrology in a manner that could eradicate sensitive plant species and reduce the water quality function of the wetlands. The State listed red flowered pitcher plant (*Sarracenia rubra*) and water sundew (*Drosera intermedia*) and many other herbaceous species identified to occur within the seepage slope bog on the western headwater stream segment of Blount Mill Creek are restricted to fire maintained wetland ecosystems.

### 3.3.1 Woody Species Fire Effects

In the absence of fire, titi (*Cyrilla racemiflora*) sweetbay (*Mahonia virginiana*), and gallberry (*Ilex glabra*) are generally found in abundance on some TA C-62 wetland sites, reducing the density and diversity of herbaceous ground cover. Over time, dominance of wood shrubs in wetlands degrades the wildlife and water quality values and function of the site. However, these native woody species can be effectively controlled with periodic burning.

#### Titi

Fire typically top kills aboveground portions of titi. Two successive burns of a stand of titi in Texas resulted in the top killing of 77 percent of 1 to 5 inch saplings (Silker, 1955). It generally responds to fire by sprouting from adventitious buds on the root or established seedlings from seed stored in the soil.

#### Sweetbay

Sweetbay is easily killed by fire; repeated burnings may eliminate it from the site. It may sprout from surviving root collars following fire top kill. Because of a layer of cork beneath a thin bark, older trees are relatively resistant to fire and do not burn easily.

#### Gallberry

Typically, moderate to severe fires burn the entire aerial portion of gallberry shrubs, killing the stem. However gallberry is a fire survivor and normally sprouts vigorously from dormant buds on the root crown or forms rhizomes after fire with the most vigorous growth occurring in the first year following burning.

Successive annual fires effectively control gallberry with summer fires being the most effective. Winter burns must be conducted more frequently to attain the same level of control as summer fires.

### 3.3.2 Burn Procedures

Because of its greater resistance to burning than titi or sweetbay, gallberry may be used as a benchmark for determining the effectiveness of wetland burning controls. Recommended TA C-62 wetland management prescribed burning procedures are as follows:

- Fires should be annual for the first few years until brush cover decreases, then switch to a two year cycle.
- Attempt to burn alternative blocks or strips of wetlands. Leave unburned patches and do not attempt to reignite them.
- Use a with-the-wind head fire to reduce damage to plant growth points and maximize fire control. Avoid using back burns because of their tendency to raise ground temperatures and promote the lateral movement of the fire front, which makes fire control more difficult.
- Do not burn during especially dry years or when weather conditions are consistently unsuitable.
- It is critical to monitor and record the effects of each burn event in order to make beneficial adjustments in burn procedures. Photographs before and after burn are particularly useful.

## 4. CONTAMINANT MANAGEMENT

This section provides proposed BMPs to manage potential and identified chemical contaminants on TA C-62. Historic unexploded ordnance (UXO) and CE-EOD OB/OD operations has been identified as sources of test area debris and sources of explosive residue groundwater contamination. Proposed actions designed to minimize chemical material impact potentials include the CE-EOD OB/OD area surface UXO and debris recovery, historic UXO corrosion control, CE-EOD OB/OD unit soil disturbance management, and installation of a phytoremediation groundwater stabilization/treatment system along the headwater stream segment of Blount Mill Creek within Erosion Impact Area 1.

### 4.1 INTRODUCTION

CE-EOD OB/OD operations have been identified as a source of groundwater contamination by explosives residues, and there is groundwater monitoring data that supports the contention that historic UXO associated with target TT-1 may also be a source of groundwater contamination. Explosive materials including hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), 1,3,5-trinitrobenzene, 2-amino-4,6-dinitrotoluene (2-amino-4,6-DNT), 4-amino-2,6-dinitrotoluene (2,6-DNT), 2,4-dinitrotoluene (2,4-DNT), 3-nitrotoluene, pentaerythritol tetranitrate (PETN), 1,3,5-trinitrobenzene, nitroglycerin have been detected in groundwater up and down gradient of the CE EOD OB/OD unit. Of these compounds, nitroglycerin, 4-amino-2,6-DNT, and 2,4-DNT were detected in groundwater samples at concentrations that exceeded Florida drinking water standards and/or OB/OD unit permit criteria.

A series of Best Management Practices (BMPs) are proposed to address historic and current potential sources of groundwater contamination. There is a risk of offsite contaminant transport since the affected groundwater is a primary source of stream flow for Blount Mill Creek and a sensitive seepage slope bog along its banks. Blount Mill Creek passes through a relatively pristine Longleaf Sandhill Pine Tier I habitat located immediately south of TA C-62.

The intention of Contaminant Management BMPs is to offer practical, cost-effective solutions that minimize surface water and groundwater contamination potentials by:

- Removing surface UXO and debris from the affected area
- Reducing historic UXO metal casing corrosion potentials by reducing over acidity of the affected area
- Minimizing CE-EOD OB/OD unit soil disturbances

- Immobilizing and degrading groundwater explosives contaminants through phytoremediation technologies

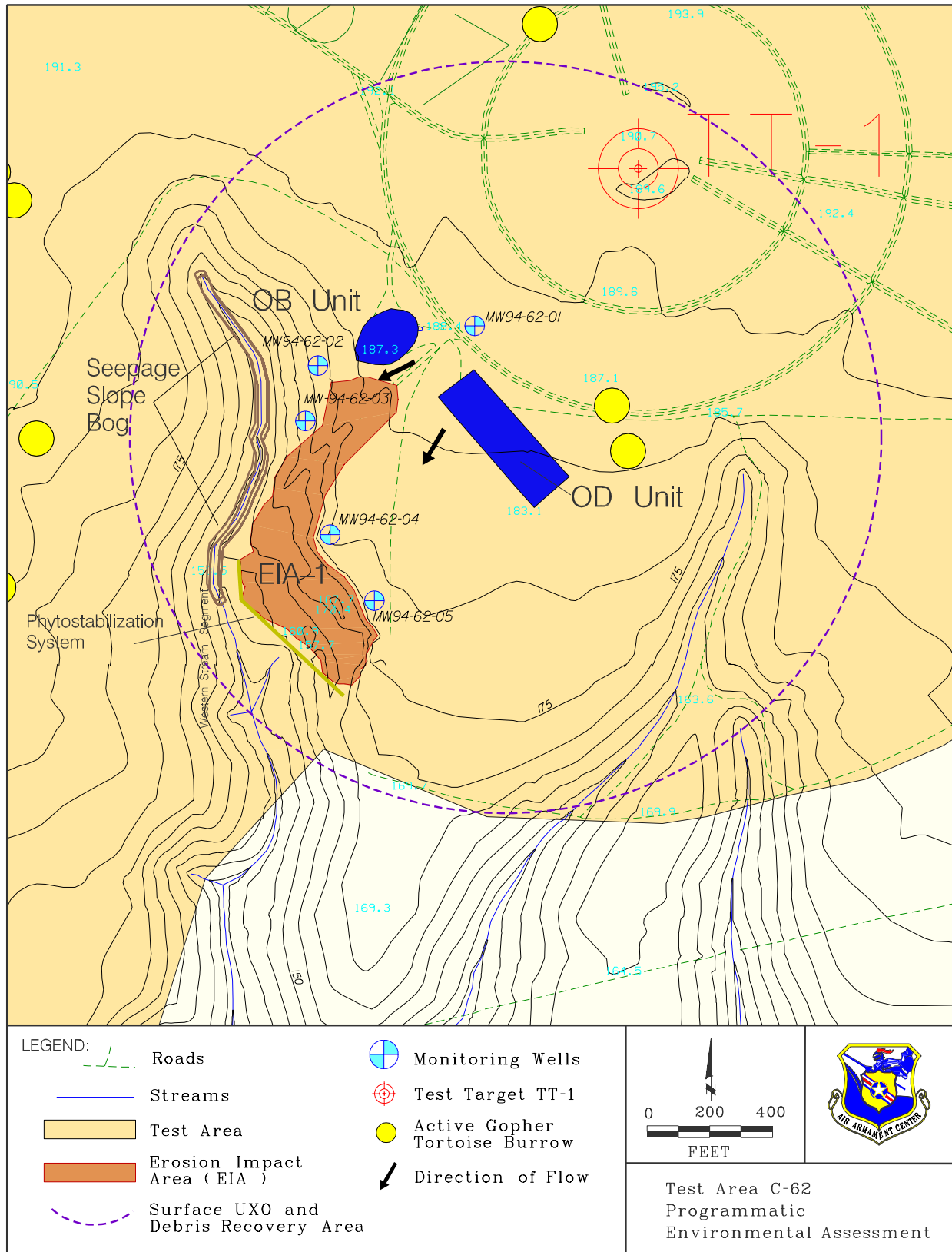
### 4.2 CE-EOD OB/OD AREA SURFACE UXO AND DEBRIS RECOVERY

An initial step to TA C-62 contaminant management is the recovery of UXO and debris associated with CE-EOD OB/OD operations. Expended and demilled ordnance materials would be recovered from lands within 1,200 feet of the OB/OD unit (Figure A-4). CE EOD would manage the recovery and disposal operations. Foot and wheeled traffic would be restricted from the seepage slope bog wetland adjacent to Blount Mill Creek to prevent extensive disturbance of this sensitive habitat.

The termination of traditional kettle open burn events by CE-EOD and transition to technology capable of complete thermal destruction of munitions wastes while minimizing the production of surface UXO/debris and emissions is being implemented through the use of a Transportable Burn Kettle Processor (TBKP). No shrapnel or other materials are released from the kettle during the combustion process.

### 4.3 CE-EOD OB/OD UNIT SOIL DISTURBANCE MANAGEMENT

The CE-EOD predetonation shallow pit excavations and the blast effects of large explosions are displacing enough soil from the pits to expose groundwater to direct contamination by explosive residues. Materials deposited along the rim of the crater and on the crater walls would easily wash directly into the groundwater at the bottom of the crater during subsequent rainfall events. The depth to the water table within the detonation area is approximately 16 feet.



**Figure A-4. CE-EOD Surface UXO and Debris Recovery Area and Groundwater Phytoremediation/Stabilization System**

To minimize surface disturbance and groundwater exposure potentials within the CE-EOD OB/OD unit, the following BMPs are proposed:

- Fill in the existing open detonation pits with soil flush with the existing surface elevation.
- Terminate open detonation pit construction.
- Rotate surface flush open detonation events within the permitted area, avoiding repeated detonation in the same location. Repair disturbed soil as required.

#### 4.4 GROUNDWATER PHYTOREMEDIATION/ STABILIZATION TREATMENT SYSTEM

Phytoremediation is the use of vegetation for in situ treatment of contaminated soils, sediments, surface water, and groundwater. It is proposed that a phytoremediation/stabilization treatment be installed at an appropriate location to promote the degradation and immobilization of groundwater borne explosive residues. Case studies that exemplify groundwater vegetation treatment systems are discussed in the section below followed by treatment systems recommendations for TA C-62.

##### 4.4.1 Phytoremediation Case Studies

Case studies at Naval Air Station, Fort Worth, Texas; Aberdeen Proving Grounds, Edgewood, Maryland; and Edward Sears Property, New Gretna, New Jersey, were initiated to control groundwater flow and treat contaminants using woody phreatophytes. These case studies, briefly discussed in the following narrative, were summarized from the documents *Draft Protocol for Controlling Contaminated Groundwater by Phytostabilization* (Hauser, 1999) developed for the Air Force Center for Environmental Excellence and *Phytoremediation of TCE Using Populus* (Chappell, 1998).

Naval Air Station Fort Worth (formally Carswell AFB) – Fort Worth, Texas

**Purpose:** Contain and remediate a trichloroethylene (TCE) plume in an alluvial aquifer approximately 6 to 11 feet below the ground surface. TCE concentrations averaged 610 ppb.

**Procedures:** A total of 660 eastern cottonwood (*Populus deltoids*) trees were planted in two elongated areas perpendicular to the direction of groundwater flow in 1996. Groundwater monitoring wells and piezometers were installed

throughout the site to monitor groundwater chemistry and levels.

**Results:** Sixteen months after planting, the cottonwood whips had grown 20 feet and the 5-gallon trees experienced even faster growth. Tree root interception of groundwater was confirmed by presence of TCE in tree tissues and test trench excavations. During 1997, the largest trees were transpiring 3.75 gallons per day. Lower transpiration rates were observed to occur on cloudy days. Average TCE concentrations have been reduced to 550 ppb over a period of 7 months. Project is continuing with expanded monitoring.

Aberdeen Proving Grounds – Edgewood, Maryland

**Purpose:** Contain and remediate a chlorinated solvent plume (including TCE, PCE, TCA, 1122-TCA) in a perched water table 2 to 8 feet below the ground surface. The treatment site was used for open pit burning of chemical agents, white phosphorous, high explosives, and riot control agents. Total volatile organic compounds (VOC) groundwater concentrations ranged from 20,000 ppb to 220,000 ppb.

**Procedures:** Following phytotoxicity testing, a total of 183 hybrid poplars (*Populus trichocarpa x deltoides* HP-510) were planted in 4 areas totaling approximately 1 acre in 1996. Monitoring wells and lysimeters were installed on the site.

**Results:** In May 1997, the water table beneath the trees had been lowered about 2 feet and the trees were transpiring 2 to 10 gallons per day. Tree tissue samples indicate the presence of trichloroacetic acid, a breakdown product of TCE. Chlorinated solvents (TCE and 1,1,2,2-tetrachloroethane) are being evapotranspired by the trees. As of 1998, 10 percent of the trees had died from frost, deer damage, and insects. Project monitoring continues.

Edward Sears Property – New Gretna, New Jersey

**Purpose:** Contain and remediate VOCs including TCE and PCE in contaminated groundwater approximately 9 feet below ground surface. Hazardous materials handled at the site included paints, adhesives, paint thinners, and military surplus materials. TCE concentrations ranged from 0 to 390 ppb.

**Procedures:** A total of 208 hybrid poplars (*Populus carkowiiensis x incrassata* NE 308) were planted on a 0.3 acre plot in 1996.

Groundwater, soil, soil gas, plant tissue, and evapotranspiration gas were monitored.

*Results:* The trees grew 30 inches in the first 7 months. Evapotranspiration gas sampling data has shown that the trees are evapotranspiring VOCs. Project monitoring continues.

#### 4.4.2 CE-EOD Site Groundwater Treatment System

Once the EIA-1 stream slope has been restored and stabilized by native grasses, attention can be directed toward establishing a self-sustaining, low maintenance groundwater contamination biodegradation/stabilization treatment system at the TA C-62 CE-EOD OB/OD site. The proposed general location of the treatment system is presented in Figure A-4.

The groundwater interception system would be based on the use of woody species with adaptations to the site and proven treatment capabilities. Hybrid poplar (*Populus deltoids x nigra* DN-34, Imperial California, *Populus charkowiiensis x incrassata*; *Populus tricocarpa x deltoides*) is the primary species that is used in combination with red mulberry (*Morus rubra*), willow (*Salix spp.*), and cottonwood (*Populus deltoids*) to maximize groundwater interception and treatment capabilities.

Individual trees would be planted at design intervals to ensure groundwater interception and at densities that afford treatment without adversely altering the overall hydrology of the western headwater segment of Blount Mill Creek.

General system design considerations include:

- Characterization of site-specific climatic variables and treatment media, geohydrology, and contaminants of concern
- Evaluation of site-specific opportunities and limitations
- Avoidance of military mission conflicts
- Screening and selection of vegetation species that address media/contaminant/treatment goals
- System design, construction, and maintenance
- Monitoring



## 5. NOISE MANAGEMENT

This section proposes a noise management BMP for minimizing potential public and wildlife resource noise impacts associated with CE-EOD open detonation (OD) missions on TA C-62.

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### 5.1 INTRODUCTION

Noise is an unavoidable consequence of military mission training and testing on TA C-62, and to approach noise management as a soundproofing issue is impractical and unachievable. However there are opportunities to minimize potential noise impacts to wildlife and the public and promote the coexistence of mission activities and surrounding communities.

Within the realm of mission activities currently performed at TA C-62, CE-EOD OD events have been identified as having the greatest potential impact to on- and off-site noise environments. Even though CE-EOD OD operations are performed under USEPA permit requirements of wind speeds between 3 and 15 miles per hour and no inversion forecasts, noise modeling analysis has identified potential public exposure to 115 dBP noise during these favorable weather conditions. The Eglin Detail Noise Complaint Report database has also recorded noise complaints from the public outside of the boundaries of Eglin associated with TA C-62 open detonation events.

Options for abating impulse noise from open detonations at the source are limited. Potential opportunities include regulating OD event operating hours to reduce noise intrusion during noise sensitive hours, complete or partial enclosures, separating the noise source from the receiver to the extent possible, and reducing the amount of explosives expended per OD event.

Public noise sensitivity time period criteria were not available to structure low noise impact CE-EOD OD windows of operation.

It is not uncommon for noise to be transmitted upwards and focused downwards many miles away, which could render terrain, barriers, and enclosures relatively ineffective. Where sound travels along the ground, a barrier would have to be quite close to be effective. Without total enclosure there is also a high probability of reflecting and/or concentrating noise to other points.

Because of limited space and allocation of mission resources, there are limited opportunities to increase the distance between the TA C-62 noise source and public and wildlife resource receivers.

Limits to open detonation event net explosive weight are identified as the most practical and viable option of those presented.

### 5.2. CE-EOD OPEN DETONATION EVENT NEW LIMITS

The OD NEW limit BMP would reduce the current 3,000 lb NEW per detonation event limit to 1,000 lb NEW per detonation event. The reduction in the amount of explosives expended during a detonation event would decrease noise generated and minimize detonation pad soil displacement. The extent of potential exposure of the public to 115 dBP noise generated by CE-EOD detonations under favorable conditions could be reduced by approximately 27 percent.

As with other BMPs, a combination of measures often brings the maximum results. The 1,000 lb NEW OD limits in combination with continued use of favorable weather forecast scheduling could minimize potential noise impacts on the public and wildlife resources.

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**APPENDIX B**

**RELEVANT AND PERTINENT LAWS, REGULATIONS,  
AND POLICIES**

## RELEVANT AND PERTINENT LAWS, REGULATIONS, AND POLICIES

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The Environmental Baseline Document was prepared with consideration of and compliance with relevant and pertinent environmental laws, regulations, and policies. This section includes federal executive orders and laws; Department of Defense (DoD) directives and instructions; Air Force instructions and policy directives; and Florida state statutes and administrative codes. This list has been compiled and limited to include the most relevant laws, regulations, and policies, which are pertinent to the specific mission activities defined in this document. It is further recognized that additional laws and regulations may exist and will be included with subsequent updates.

### General

**32 CFR Part 989;** 15-Jul-99; The Environmental Impact Analysis Process. The Instruction provides a framework for how the Air Force is to comply with NEPA and the CEQ regulations.

**42 USC 4321 et seq;** 1969; National Environmental Policy Act of 1969 (NEPA); Requires that federal agencies (1) consider the consequences of an action on the environment before taking the action and (2) involve the public in the decision making process for major federal actions that significantly affect the quality of the human environment.

**Executive Order 12372;** 14-Jul-82; Intergovernmental Review of Federal Programs; Directs federal agencies to inform states of plans and actions, use state processes to obtain state views, accommodate state and local concerns, encourage state plans, and coordinate states' views.

**Executive Order 12856;** 3-Aug-93; Right to Know Laws and Pollution Prevention Requirements; Directs all Federal agencies to incorporate pollution planning into their operations and to comply with toxic release inventory requirements, emergency planning requirements, and release notifications requirements of EPCRA.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution prevention.

**Air Force Instruction 32-7045;** 1-Apr-94; Environmental Compliance and Assessment; Implements AFPD 32-70 by providing for an annual

internal self-evaluation and program management system to ensure compliance with Federal, State, local, DoD, and Air Force environmental laws and regulations.

**Air Force Instruction 32-7062;** 1-Apr-94; Air Force Comprehensive Planning; Implements AFPD 32-70 by establishing Air Force Comprehensive Planning Program for development of Air Force Installations, ensuring that natural, cultural, environmental, and social science factors are considered in planning and decision making.

### Physical Resources

#### *Air Quality*

**42 USC 7401 et seq.; 40 CFR Parts 50 & 51;** 1996; Clean Air Act, National Ambient Air Quality Standards (CAA, NAAQS); Emission sources must comply with air quality standards and regulations established by federal, state, and local regulatory agencies.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution prevention. Implements Clean Air Act.

**Air Force Instruction 32-7040;** 9-May-94; Air Quality Compliance; This AFI sets forth actions for bases to implement to achieve and maintain compliance with applicable standards for air quality compliance, and responsibilities for who is to implement them. Includes requirements for NEPA and RCRA as well as CAA.

**F.S. Ch. 403, Part I;** 1996; Florida Air and Water Pollution Control Act; Regulates air pollution within the state.

**F.A.C. Chap. 62-204;** 1996; Florida State Implementation Plan, with Ambient Air Quality Standards and PSD Program; Establishes state air quality standards and requirements for maintaining compliance with NAAQS.

#### *Air Space Use*

**49 USC 106 & Subtitle VII;** 1997-Supp; Federal Aviation Act of 1958 (FAA); Created the FAA and establishes administrator with responsibility of

ensuring aircraft safety and efficient utilization of the National Airspace System.

**14 CFR Part 71;** 1997; Federal Aviation Regulation (FAR); Defines federal air routes, controlled airspace, and flight locations for reporting position.

**14 CFR Part 73;** 1997; Federal Aviation Regulation (SFAR No. 53); Defines and prescribes requirements for special use airspace.

**14 CFR Part 91;** 1997; Federal Aviation Regulation (FAR); Governs the operation of aircraft within the United States, including the waters within three nautical miles of the U.S. Coast. In addition, certain rules apply to persons operating in airspace between three and 12 nautical miles from the U.S. Coast.

### *Land Resources*

**16 USC 670a to 670o;** 1997-Supp; Sikes Act, Conservation Programs on Military Reservations; DoD, in a cooperative plan with DOI and State, opens AF bases to outdoor recreation, provides the state with a share of profits from sale of resources (timber), and conserves and rehabilitates wildlife, fish, and game on each reservation. AF is to manage the natural resources of its reservations to provide for sustained multipurpose use and public use

**USC 1701 et seq., (Public Law 94-579;** 1997-Supp; Federal Land Policy and Management Act of 1976 (FLPMA); Provides that the Secretary of Interior shall develop land use plans for public lands within BLM jurisdiction to protect scientific, scenic, historical, ecological, environmental and archeological values, and to accommodate needs for minerals, food and timber.

**Air Force Instruction 32-7062;** 1-Apr-94; Air Force Comprehensive Planning; Implements AFD 32-70 by establishing Air Force Comprehensive Planning Program for development of Air Force Installations, ensuring that natural, cultural, environmental, and social science factors are considered in planning and decision making.

**Air Force Instruction 32-7063;** 31-Mar-94; Air Installation Compatible Use Zone Program (AICUZ); Provides a framework to promote compatible development within area of AICUZ area of influence and protect Air Force operational capability from the effects of land use which are incompatible with aircraft operations.

**Air Force Instruction 32-7064** 22-Jul-94; Integrated Natural Resources Management; Provides for development of an integrated natural resources management plan to manage the installation ecosystem and integrate natural resources management with the rest of the installation's

mission. Includes physical and biological resources and uses.

### *Noise*

**42 USC 4901 to 4918, Public Law 92-574;** 1997-Supp; Noise Control Act of 1972 (NCA); Provides that each Federal agency must comply with Federal, State, interstate and local requirements for control and abatement of environmental noise.

**49 USC 44715;** 1997-Supp; Controlling Aircraft Noise and Sonic Boom; Provides that the FAA will issue regulations in consultation with the USEPA to control and abate aircraft noise and sonic boom.

**Executive Order 12088;** 1978; Federal Compliance with Pollution Control Standards; Requires the head of each executive agency to take responsibility for ensuring all actions have been taken to prevent, control, and abate environmental (noise) pollution with respect to federal activities.

### *Water Resources*

**33 USC 1251 et seq.;** 1997-Supp; Clean Water Act (CWA) (Federal Water Pollution Prevention and Control Act, FWPCA); In addition to regulating navigable water quality, the CWA establishes NPDES permit program for discharge into surface waters and storm water control; Army Corps of Engineers permit and state certification for wetlands disturbance; regulates ocean discharge; sewage wastes control; and oil pollution prevention.

**33 USC 1344-Section 404;** 1997-Supp; Clean Water Act (CWA) (Federal Water Pollution Control Act, FWPCA), Dredged or Fill Permit Program; Regulates development in streams and wetlands by requiring a permit from the Army Corps of Engineers for discharge of dredged or fill material into navigable waters. A Section 401 (33 USC 1341) Certification is required from the state as well.

**42 USC 300f et seq.;** 1997-Supp; Safe Drinking Water Act (SDWA); Requires the promulgation of drinking water standards, or MCLs, which are often used as cleanup values in remediation; establishes the underground injection well program; and establishes a wellhead protection program.

**42 USC 6901 et seq.;** 29-May-05; Resource Conservation and Recovery Act of 1976 (RCRA); Establishes standards for management of hazardous waste so that water resources are not contaminated: RCRA Corrective Action Program requires cleanup of groundwater that has been contaminated with hazardous constituents.



**42 USC 9601 et seq., Public Law 96-510;** 11-Dec-80; Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); Establishes the emergency response and remediation program for water and groundwater resources contaminated with hazardous substances.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution prevention. Implements Clean Water Act, Safe Drinking Water Act, and Water Quality Act of 1987.

**Air Force Instruction 32-7041;** 13-May-94; Water Quality Compliance; Instructs the Air Force on maintaining compliance with the Clean Water Act; other federal, state, and local environmental regulations; and related DoD and AF water quality directives.

**Air Force Instruction 32-7064;** 22-Jul-94; Integrated Natural Resources Management; Sets forth requirements for addressing wetlands, floodplains and coastal and marine resources in an integrated natural resources management plan (INRMP) for each installation.

**Florida Statutes Chap. 403, Part I;** Florida Air and Water Pollution Control Act; Establishes the regulatory system for water resources in Florida.

**Florida Administrative Code Chap. 62-302;** 1995; Surface Water Quality Standards; Classifies Florida surface waters by use. Identifies Outstanding Florida Waters.

**Florida Administrative Code Chap. 62-312;** 1995; Florida Dredge and Fill Activities; Requires a state permit for dredging and filling conducted in, on, or over the surface waters of the state.

## Biological Resources

### Animal Resources

**16 USC 668 to 668d;** 1995; Bald and Golden Eagle Protection Act (BGEPA); Makes it illegal to take, possess, sell, barter, offer to sell, transport, export or import Bald and Golden eagles in the United States. Taking may be allowed for scientific, exhibition, or religious purposes, or for seasonal protection of flocks.

**16 USC 703 - 712;** 1997-Supp; Migratory Bird Treaty Act (MBTA); Makes it illegal to take, kill or possess migratory birds unless done so in accordance with regulations. An exemption may be obtained from the Dept. of the Interior for taking a listed migratory bird.

**Air Force Instruction 32-7064;** 22-Jul-94; Integrated Natural Resources Management; Explains how to manage natural resources on Air Force property, and to comply with Federal, State, and local standards for resource management.

### Threatened and Endangered Species

**16 USC 668 to 668d;** 1995; Bald and Golden Eagle Protection Act (BGEPA); Makes it illegal to take, possess, sell, purchase, barter, transport, export or import, at any time in any manner, any bald or golden eagle, unless done in accordance with regulations or permit conditions.

**16 USC 1531 to 1544-16 USC 1536(a);** 1997-Supp; Endangered Species Act 1973 (ESA); Federal agencies must ensure their actions do not jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify the habitat of such species and must set up a conservation program.

**50 CFR Part 402;** 1996; Endangered Species Act - Interagency Cooperation; These rules prescribe how a Federal agency is to interact with either the FWS or the NMFS in implementing conservation measures or agency activities.

**50 CFR Part 450;** 1996; Endangered Species Exemption Process; These rules set forth the application procedure for an exemption from complying with Section 7(a)(2) of the ESA, 16 USC 1536(a)(2), which requires that Federal agencies ensure their actions do not affect endangered or threatened species or habitats.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution prevention. Implements Endangered Species Act.

**Air Force Instruction 32-7064;** 22-Jul-94; Integrated Natural Resources Management; This AFI directs an installation to include in its INRMP procedures for managing and protecting endangered species or critical habitat, including State-listed endangered, threatened or rare species; and discusses agency coordination.

### Human Safety

**29 CFR 1910.120;** 1996; Occupational Safety and Health Act, Chemical Hazard Communication Program (OSHA); Requires that chemical hazard identification, information and training be available to employees using hazardous materials and institutes material safety data sheets (MSDS) which provide this information.

**Department of Defense Instruction 6055.1;** Establishes occupational safety and health guidance for managing and controlling the reduction of radio frequency exposure.

**Department of Defense Flight Information Publication;** Identifies regions of potential hazard resulting from bird aggregations or obstructions, military airspace noise sensitive locations, and defines airspace avoidance measures.

**Air Force Instruction 32-2001;** 16-May-94; The Fire Protection Operations and Fire Prevention Program; Identifies requirements for Air Force fire protection programs (equipment, response time, and training).

**Air Force Instruction 32-7063;** 1-Mar-94; Air Installation Compatible Use Zone Program (AICUZ). The AICUZ Study defines and maps accident potential zones and runway clear zones around the installation, and contains specific land use compatibility recommendations based on aircraft operational effects and existing land use, zoning and planned land use.

**Air Force Manual 91-201;** 12-Jan-96; Explosives Safety Standards; Regulates and identifies procedures for explosives safety and handling as well as defining requirements for ordnance quantity distances, safety buffer zones, and storage facilities.

**Air Force Instruction 91-301;** 1-Jun-96; Air Force Occupational and Environmental Safety, Fire Protection and Health (AFOSH) Program; Identifies occupational safety, fire prevention, and health regulations governing Air Force activities and procedures associated with safety in the workplace.

#### *Habitat Resources*

**Executive Order 11990;** 24-May-77; Protection of Wetlands; Requires federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in their activities. Construction is limited in wetlands and requires public participation.

**Executive Order 11988;** 24-May-77; Floodplain Management; Directs Federal agencies to restore and preserve floodplains by performing the following in floodplains: not supporting development; evaluating effects of potential actions; allowing public review of plans; and considering in land and water resource use.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution

prevention. Implements Executive Order 11988 and 11990.

#### **Anthropogenic Resources**

##### *Hazardous Materials*

**7 USC 136 et seq., Public Law 92-516;** 1997-Supp; Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); Establishes requirements for use of pesticides that may be relevant to activities at Eglin Air Force Base.

**42 U.S.C. Sect. 2011 - Sect. 2259;** 1997-Supp; Atomic Energy Act of 1954 (AEA); Assures the proper management of source, special nuclear, and byproduct radioactive materials.

**42 USC 6901 et seq.;** 1980; Resource Conservation and Recovery Act of 1976 and Solid Waste Disposal Act of 1980 (RCRA); Subchapter III sets forth hazardous waste management provisions; Subchapter IV sets forth solid waste management provisions; and Subchapter IX sets forth underground storage tank provisions; with which Federal agencies must comply.

**42 USC 9601 et seq., Public Law 96-510;** 1997-Supp; Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA); Establishes the liability and responsibilities of federal agencies for emergency response measures and remediation when hazardous substances are or have been released into the environment.

**42 USC 11001 to 11050;** 1995; Emergency Planning and Community Right-to-Know Act (EPCRA); Provides for notification procedures when a release of a hazardous substance occurs; sets up community response measures to a hazardous substance release; and establishes inventory and reporting requirements for toxic substances at all facilities.

**42 USC 13101 to 13109;** 1990; Pollution Prevention Act of 1990 (PPA); Establishes source reduction as the preferred method of pollution prevention, followed by recycling, treatment, then disposal into the environment. Establishes reporting requirements to submit with EPCRA reports. Federal agencies must comply.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Provides for developing and implementing an Air Force Environmental Quality Program composed of four pillars: cleanup, compliance, conservation and pollution prevention. Implements Resource Recovery and Conservation

Act, Comprehensive Environment Response Compensation and Liability Act of 1980, Emergency Planning and Community Right-to-Know Act, Pollution Prevention Act, Executive Order 12088, Executive Order 12777, and Executive Order 12586. Implements DoD Instruction 4120.14, DoD Directive 4210.15, and DoD Directive 5030.41.

**Air Force Instruction 32-7080;** 12-May-94; Pollution Prevention Program; Each installation is to develop a pollution prevention management plan that addresses ozone depleting chemicals; EPA 17 industrial toxins; hazardous and solid wastes; obtaining environmentally friendly products; energy conservation, and air and water.

### *Cultural Resources*

**10 USC 2701 note, Public Law 103-139;** 1997-Supp; Legacy Resource Management Program (LRMP); Provides funding to conduct inventories of all scientifically significant biological assets of Eglin AFB.

**16 USC 431 et seq.; PL 59-209; 34 Stat. 225; 43 CFR 3;** 1906; Antiquities Act of 1906; Provides protection for archeological resources by protecting all historic and prehistoric sites on Federal lands. Prohibits excavation or destruction of such antiquities without the permission (Antiquities Permit) of the Secretary of the department which has the jurisdiction over those lands.

**16 USC 461 to 467;** 1997-Supp; Historic Sites, Buildings and Antiquities Act (HAS); Establishes national policy to preserve for public use historic sites, buildings and objects of national significance: the Secretary of the Interior operates through the National Park Service to implement this national policy.

**16 USC 469 to 469c-1;** 1997-Supp; Archaeological and Historic Preservation Act of 1974 (AHPA); Directs Federal agencies to give notice to the Secretary of the Interior before starting construction of a dam or other project that will alter the terrain and destroy scientific, historical or archeological data, so that the Secretary may undertake preservation.

**16 USC 470aa-470mm, Public Law 96-95;** 1997-Supp; Archaeological Resources Protection Act of 1979 (ARPA); Establishes permit requirements for archaeological investigations and ensures protection and preservation of archaeological sites on federal property.

**16 USC 470 to 470w-6-16 USC 470f, 470h-2;** 1997-Supp; National Historic Preservation Act (NHPA); Requires Federal agencies to (1) allow the Advisory Council on Historic Preservation to comment before

taking action on properties eligible for the National Register and (2) preserve such properties in accordance with statutory and regulatory provisions.

**25 USC 3001 - 3013), (Public Law 101-601;** 1997-Supp; Native American Graves Protection and Repatriation Act of 1991 (NAGPRA); Federal agencies must obtain a permit under the Archeological Resources Protection Act before excavating Native American artifacts. Federal agencies must inventory and preserve such artifacts found on land within their stewardship.

**42 USC 1996;** 1994; American Indian Religious Freedom Act (AIRFA); Federal agencies should do what they can to ensure that American Indians have access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites in the practice of their traditional religions.

**32 CFR Part 200;** 1996; Protection of Archaeological Resources: Uniform Regulations; Provides that no person may excavate or remove any archaeological resource located on public lands or Indian lands unless such activity is conducted pursuant to a permit issued under this Part or is exempted under this Part.

**36 CFR Part 60;** 1996; Nominations to National Register of Historic Places; Details how the Federal agency Preservation Officer is to nominate properties to the Advisory Council for consideration to be included on the National Register.

**36 CFR Part 800;** 1995; Protection of Historic and Cultural Properties; Sets out the Section 106 process for complying with Sections 106 and 110 of the NHPA: the Agency official, in consultation with the State Historic Preservation Officer (SHPO), identifies and evaluates affected historic properties for the Advisory Council.

**Executive Order 11593, 16 USC 470;** 13-May-71; Protection and Enhancement of the Cultural Environment; Instructs federal agencies to identify and nominate historic properties to the National Register, as well as avoid damage to Historic properties eligible for the National Register.

**Executive Order 13007;** 24-May-96; Directs federal agencies to provide access to and ceremonial use of sacred Indian sites by Indian religious practitioners as well as promote the physical integrity of sacred sites.

**DoD Directive 4710.1;** Archaeological and Historic Resources Management (AHRM); Establishes policy requirements for archaeological and cultural resource protection and management for all military lands and reservations.

**Air Force Policy Directive 32-70;** 20-Jul-94; Environmental Quality; Develops and implements the Air Force Environmental Quality Program composed of cleanup, compliance, conservation, and pollution prevention. Implements National Historic Preservation Act, Executive Order 11593, and DoD Directive 470.1.

**Air Force Instruction 32-7065;** 13-Jun-94; Cultural Resource Management; Directs AF bases to prepare cultural resources management plans (CRMP) to comply with historic preservation requirements, Native American considerations; and archeological resource protection requirements, as part of the Base Comprehensive Plan.

**Air Force Policy Letter;** 4-Jan-82; Establishes Air Force policy to comply with historic preservation and other federal environmental laws and directives.

## **FLORIDA WATERSHED RESTORATION ACT OF 1999**

## CHAPTER 99-223

## Committee Substitute for Senate Bill No. 2282

An act relating to implementation of water quality standards; amending s. 403.031, F.S.; defining the term “total maximum daily load”; creating s. 403.067, F.S.; providing legislative findings and intent; requiring the Department of Environmental Protection to periodically submit to the United States Environmental Protection Agency a list of surface waters or segments for which total maximum daily load assessments will be conducted; providing that the list cannot be used in the administration or implementation of any regulatory program; providing for public comment on the list; requiring the Department of Environmental Protection to conduct total maximum daily load assessments on water bodies based on the priority ranking and schedule; requiring the Department of Environmental Protection to adopt a methodology for determining those water bodies which are impaired by rule; specifying what the rule shall set forth; providing for the adoption of a subsequent updated list of water bodies for which total maximum daily loads will be calculated under certain circumstances; providing for the removal of surface waters or segments under certain conditions; providing for the process for calculating and allocating total maximum daily loads; providing that the Department of Environmental Protection must submit a report by February 1, 2001, to the Governor, the President of the Senate, and the Speaker of the House of Representatives which contains recommendations and draft legislation for any modifications to the process for allocating total maximum daily loads; requiring that the recommendations be developed by the department in cooperation with a technical committee; providing that the total maximum daily load calculations and allocations shall be adopted by rule; providing for public workshops and public notice; providing that the Department of Environmental Protection shall be the lead agency in coordinating the implementation of the total maximum daily load allocation through water quality protection programs; authorizing the department to develop a basin plan requiring the department to cooperatively develop suitable interim measures, best management practices, or other measures necessary to achieve the level of pollution reduction established in allocations for nonagricultural nonpoint pollutant sources; requiring the Department of Agriculture and Consumer Services to develop, and to adopt by rule at its discretion, certain interim measures or best management practices necessary to achieve the level of pollution reduction established in allocations of agricultural pollutant sources; authorizing the Department of Environmental Protection to adopt certain rules; prohibiting the Department of Environmental Protection from implementing, without prior legislative approval, any additional regulatory authority pursuant to the Clean Water Act; amending s. 403.805, F.S.; providing for the powers and duties of the secretary; requiring the Department of Environmental Protection, in coordination with the water management district and the Department of

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CODING: Words ~~stricken~~ are deletions; words underlined are additions.

Agriculture and Consumer Services, to evaluate the effectiveness of the implementation of total maximum daily loads for a specific period and to report to the Governor and the Legislature; providing an effective date.

Be It Enacted by the Legislature of the State of Florida:

Section 1. Short title.—This act may be cited as the “Florida Watershed Restoration Act.”

Section 2. Subsection (21) is added to section 403.031, Florida Statutes, to read:

403.031 Definitions.—In construing this chapter, or rules and regulations adopted pursuant hereto, the following words, phrases, or terms, unless the context otherwise indicates, have the following meanings:

(21) “Total maximum daily load” is defined as the sum of the individual wasteload allocations for point sources and the load allocations for nonpoint sources and natural background. Prior to determining individual wasteload allocations and load allocations, the maximum amount of a pollutant that a water body or water segment can assimilate from all sources without exceeding water quality standards must first be calculated.

Section 3. Section 403.067, Florida Statutes, is created to read:

403.067 Establishment and implementation of total maximum daily loads.—

(1) LEGISLATIVE FINDINGS AND INTENT.—In furtherance of public policy established in s. 403.021, the Legislature declares that the waters of the state are among its most basic resources and that the development of a total maximum daily load program for state waters as required by ss. 303(d) of the Clean Water Act. Pub. L. No. 92-500, 33 U.S.C. ss. 1251 et seq. will promote improvements in water quality throughout the state through the coordinated control of point and nonpoint sources of pollution. The Legislature finds that, while point and nonpoint sources of pollution have been managed through numerous programs, better coordination among these efforts and additional management measures may be needed in order to achieve the restoration of impaired water bodies. The scientifically based total maximum daily load program is necessary to fairly and equitably allocate pollution loads to both nonpoint and point sources. Implementation of the allocation shall include consideration of a cost-effective approach coordinated between contributing point and nonpoint sources of pollution for impaired water bodies or water body segments and may include the opportunity to implement the allocation through non-regulatory and incentive-based programs. The Legislature further declares that the Department of Environmental Protection shall be the lead agency in administering this program and shall coordinate with local governments, water management districts, the Department of Agriculture and Consumer Services, local soil and water conservation districts, environmental groups, regulated interests, other appropriate state agencies, and affected pollution sources in developing and executing the total maximum daily load program.

(2) LIST OF SURFACE WATERS OR SEGMENTS.—In accordance with ss. 303(d) of the Clean Water Act, Pub. L. No. 92-500, 33 U.S.C. ss. 1251 et seq., the department must submit periodically to the United States Environmental Protection Agency a list of surface waters or segments for which total maximum daily load assessments will be conducted. The assessments shall evaluate the water quality conditions of the listed waters and, if such waters are determined not to meet water quality standards, total maximum daily loads shall be established, subject to the provisions of s. 403.067(4). The department shall establish a priority ranking and schedule for analyzing such waters.

(a) The list, priority ranking, and schedule cannot be used in the administration or implementation of any regulatory program. However, this paragraph does not prohibit any agency from employing the data or other information used to establish the list, priority ranking, or schedule in administering any program.

(b) The list, priority ranking, and schedule prepared under this subsection shall be made available for public comment, but shall not be subject to challenge under chapter 120.

(c) The provisions of this subsection are applicable to all lists prepared by the department and submitted to the United States Environmental Protection Agency pursuant to section ss. 303(d) of the Clean Water Act, Pub. L. No. 92-500, 33 U.S.C. ss. 1251 et seq., including those submitted prior to the effective date of this act, except as provided in s. 403.067(4).

(d) If the department proposes to implement total maximum daily load calculations or allocations established prior to the effective date of this act, the department shall adopt those calculations and allocations by rule by the secretary pursuant to ss. 120.54, 120.536(1) and 403.067(6)(d).

(3) ASSESSMENT.—

(a) Based on the priority ranking and schedule for a particular listed water body or water body segment, the department shall conduct a total maximum daily load assessment of the basin in which the water body or water body segment is located using the methodology developed pursuant to s. 403.067(3)(b). In conducting this assessment, the department shall coordinate with the local water management district, the Department of Agriculture and Consumer Services, other appropriate state agencies, soil and water conservation districts, environmental groups, regulated interests, and other interested parties.

(b) The department shall adopt by rule a methodology for determining those waters which are impaired. The rule shall provide for consideration as to whether water quality standards codified in chapter 62-302, Florida Administrative Code, are being exceeded, based on objective and credible data, studies and reports, including surface water improvement and management plans approved by water management districts under s. 373.456 and pollutant load reduction goals developed according to department rule. Such rule also shall set forth:



1. Water quality sample collection and analysis requirements, accounting for ambient background conditions, seasonal and other natural variations;
2. Approved methodologies;
3. Quality assurance and quality control protocols;
4. Data modeling; and
5. Other appropriate water quality assessment measures.

(c) If the department has adopted a rule establishing a numerical criterion for a particular pollutant, a narrative or biological criterion may not be the basis for determining an impairment in connection with that pollutant unless the department identifies specific factors as to why the numerical criterion is not adequate to protect water quality. If water quality non-attainment is based on narrative or biological criteria, the specific factors concerning particular pollutants shall be identified prior to a total maximum daily load being developed for those criteria for that surface water or surface water segment.

(4) APPROVED LIST.—If the department determines, based on the total maximum daily load assessment methodology described in s. 403.067(3), that water quality standards are not being achieved and that technology-based effluent limitations and other pollution control programs under local, state, or federal authority, including Everglades restoration activities pursuant to s. 373.4592 and the National Estuary Program, which are designed to restore such waters for the pollutant of concern are not sufficient to result in attainment of applicable surface water quality standards, it shall confirm that determination by issuing a subsequent, updated list of those water bodies or segments for which total maximum daily loads will be calculated. In association with this updated list the department shall establish priority rankings and schedules by which water bodies or segments will be subjected to total maximum daily load calculations. If a surface water or water segment is to be listed under this subsection, the department must specify the particular pollutants causing the impairment and the concentration of those pollutants causing the impairment relative to the water quality standard. This updated list shall be approved and amended by order of the department subsequent to completion of an assessment of each water body or water body segment, and submitted to the United States Environmental Protection Agency. Each order shall be subject to challenge under ss. 120.569 and 120.57.

(5) REMOVAL FROM LIST.—At any time throughout the total maximum daily load process, surface waters or segments evaluated or listed under this section shall be removed from the lists described in s. 403.067(2) or s. 403.067(4) upon demonstration that water quality criteria are being attained, based on data equivalent to that required by rule under s. 403.067(3).

(6) CALCULATION AND ALLOCATION.—

(a) Calculation of total maximum daily load.

1. Prior to developing a total maximum daily load calculation for each water body or water body segment on the list specified in s. 403.067(4), the department shall coordinate with applicable local governments, water management districts, the Department of Agriculture and Consumer Services, other appropriate state agencies, local soil and water conservation districts, environmental groups, regulated interests, and affected pollution sources to determine the information required, accepted methods of data collection and analysis, and quality control/quality assurance requirements. The analysis may include mathematical water quality modeling using approved procedures and methods.

2. The department shall develop total maximum daily load calculations for each water body or water body segment on the list described in s. 403.067(4) according to the priority ranking and schedule unless the impairment of such waters is due solely to activities other than point and nonpoint sources of pollution. For waters determined to be impaired due solely to factors other than point and nonpoint sources of pollution, no total maximum daily load will be required. A total maximum daily load may be required for those waters that are impaired predominantly due to activities other than point and nonpoint sources. The total maximum daily load calculation shall establish the amount of a pollutant that a water body or water body segment can assimilate without exceeding water quality standards, and shall account for seasonal variations and include a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. The total maximum daily load may be based on a pollutant load reduction goal developed by a water management district, provided that such pollutant load reduction goal is promulgated by the department in accordance with the procedural and substantive requirements of this subsection.

(b) Allocation of total maximum daily loads. The total maximum daily loads shall include establishment of reasonable and equitable allocations of the total maximum daily load among point and nonpoint sources that will alone, or in conjunction with other management and restoration activities, provide for the attainment of water quality standards and the restoration of impaired waters. The allocations shall establish the maximum amount of the water pollutant from a given source or category of sources that may be discharged or released into the water body or water body segment in combination with other discharges or releases. Such allocations shall be designed to attain water quality standards and shall be based on consideration of the following:

1. Existing treatment levels and management practices;
2. Differing impacts pollutant sources may have on water quality;
3. The availability of treatment technologies, management practices, or other pollutant reduction measures;
4. Environmental, economic, and technological feasibility of achieving the allocation;

5. The cost benefit associated with achieving the allocation;
6. Reasonable timeframes for implementation;
7. Potential applicability of any moderating provisions such as variances, exemptions, and mixing zones; and
8. The extent to which nonattainment of water quality standards is caused by pollution sources outside of Florida, discharges that have ceased, or alterations to water bodies prior to the date of this act.

(c) Not later than February 1, 2001, the department shall submit a report to the Governor, the President of the Senate, and the Speaker of the House of Representatives containing recommendations, including draft legislation, for any modifications to the process for allocating total maximum daily loads, including the relationship between allocations and the basin planning process. Such recommendations shall be developed by the department in cooperation with a technical advisory committee which includes representatives of affected parties, environmental organizations, water management districts, and other appropriate local, state, and federal government agencies. The technical advisory committee shall also include such members as may be designated by the President of the Senate and the Speaker of the House of Representatives.

(d) The total maximum daily load calculations and allocations for each water body or water body segment shall be adopted by rule by the secretary pursuant to ss. 120.54 and 120.536(1), and 403.805. The rules adopted pursuant to this paragraph shall not be subject to approval by the Environmental Regulation Commission. As part of the rule development process, the department shall hold at least one public workshop in the vicinity of the water body or water body segment for which the total maximum daily load is being developed. Notice of the public workshop shall be published not less than 5 days nor more than 15 days before the public workshop in a newspaper of general circulation in the county or counties containing the water bodies or water body segments for which the total maximum daily load calculation and allocation are being developed.

(7) IMPLEMENTATION OF TOTAL MAXIMUM DAILY LOADS.—

(a) The department shall be the lead agency in coordinating the implementation of the total maximum daily load allocation through water quality protection programs. Application of a total maximum daily load calculation or allocation by a water management district shall be consistent with this section and shall not require the issuance of an order or a separate action pursuant to s. 120.54 or s. 120.536(1) for adoption of the calculation and allocation previously established by the department. Such programs may include, but are not limited to:

1. Permitting and other existing regulatory programs;
2. Nonregulatory and incentive-based programs, including best management practices, cost sharing, waste minimization, pollution prevention, and public education;

3. Other water quality management and restoration activities, for example surface water improvement and management plans approved by water management districts under s. 373.456;

4. Pollutant trading or other equitable economically based agreements;

5. Public works including capital facilities; or

6. Land acquisition.

(b) In developing and implementing the total maximum daily load allocation, the department may develop a basin plan. The basin plan will serve to fully integrate all the management strategies available to the state for the purpose of achieving water quality restoration. The basin planning process is intended to involve the broadest possible range of interested parties, with the objective of encouraging the greatest amount of cooperation and consensus possible. The department shall hold at least one public meeting in the vicinity of the basin to discuss and receive comments during the basin planning process and shall otherwise encourage public participation to the greatest practical extent. Notice of the public meeting shall be published in a newspaper of general circulation in each county in which the basin lies not less than 5 days nor more than 15 days before the public meeting. A basin plan shall not supplant or otherwise alter any assessment made under s. 403.086(3) and s.403.086(4), or any calculation or allocation made under s. 403.086(6).

(c) The department, in cooperation with the water management districts and other interested parties, as appropriate, may develop suitable interim measures, best management practices, or other measures necessary to achieve the level of pollution reduction established by the department for nonagricultural nonpoint pollutant sources in allocations developed pursuant to s. 403.067(6)(b). These practices and measures may be adopted by rule by the department and the water management districts pursuant to ss. 120.54 and 120.536(1), and may be implemented by those parties responsible for nonagricultural nonpoint pollutant sources and the department and the water management districts shall assist with implementation. Where interim measures, best management practices, or other measures are adopted by rule, the effectiveness of such practices in achieving the levels of pollution reduction established in allocations developed by the department pursuant to s. 403.067(6)(b) shall be verified by the department. Implementation, in accordance with applicable rules, of practices that have been verified by the department to be effective at representative sites shall provide a presumption of compliance with state water quality standards and release from the provisions of s. 376.307(5) for those pollutants addressed by the practices, and the department is not authorized to institute proceedings against the owner of the source of pollution to recover costs or damages associated with the contamination of surface or ground water caused by those pollutants. Such rules shall also incorporate provisions for a notice of intent to implement the practices and a system to assure the implementation of the practices, including recordkeeping requirements. Where water quality problems are detected despite the appropriate implementation, operation and maintenance of best management practices and

other measures according to rules adopted under this paragraph, the department or the water management districts shall institute a reevaluation of the best management practice or other measures.

(d) The Department of Agriculture and Consumer Services may develop and adopt by rule pursuant to ss. 120.54 and 120.536(1) suitable interim measures, best management practices, or other measures necessary to achieve the level of pollution reduction established by the department for agricultural pollutant sources in allocations developed pursuant to s. 403.067(6)(b). These practices and measures may be implemented by those parties responsible for agricultural pollutant sources and the department, the water management districts and the Department of Agriculture and Consumer Services shall assist with implementation. Where interim measures, best management practices, or other measures are adopted by rule, the effectiveness of such practices in achieving the levels of pollution reduction established in allocations developed by the department pursuant to s. 403.067(6)(b) shall be verified by the department. Implementation, in accordance with applicable rules, of practices that have been verified by the department to be effective at representative sites shall provide a presumption of compliance with state water quality standards and release from the provisions of s. 376.307(5) for those pollutants addressed by the practices, and the department is not authorized to institute proceedings against the owner of the source of pollution to recover costs or damages associated with the contamination of surface or ground water caused by those pollutants. In the process of developing and adopting rules for interim measures, best management practices, or other measures, the Department of Agriculture and Consumer Services shall consult with the department, the Department of Health, the water management districts, representatives from affected farming groups, and environmental group representatives. Such rules shall also incorporate provisions for a notice of intent to implement the practices and a system to assure the implementation of the practices, including recordkeeping requirements. Where water quality problems are detected despite the appropriate implementation, operation and maintenance of best management practices and other measures according to rules adopted under this paragraph, the Department of Agriculture and Consumer Services shall institute a reevaluation of the best management practice or other measure.

(e) The provisions of s. 403.067(7) paragraphs (c) and (d) shall not preclude the department or water management district from requiring compliance with water quality standards or with current best management practice requirements set forth in any applicable regulatory program authorized by law for the purpose of protecting water quality. Additionally, s. 403.067(7)(c) and s. 403.067(7)(d) are applicable only to the extent that they do not conflict with any rules promulgated by the department that are necessary to maintain a federally delegated or approved program.

(8) RULES.—The department is authorized to adopt rules pursuant to ss. 120.54 and 120.536(1) for:

(a) Delisting water bodies or water body segments from the list developed under s. 403.067(4) pursuant to the guidance under s. 403.067(5);

(b) Administration of funds to implement the total maximum daily load program;

(c) Procedures for pollutant trading among the pollutant sources to a water body or water body segment, including a mechanism for the issuance and tracking of pollutant credits. Such procedures may be implemented through permits or other authorizations and must be legally binding. No rule implementing a pollutant trading program shall become effective prior to review and ratification by the Legislature; and

(d) The total maximum daily load calculation in accordance with s. 403.067(6)(a) immediately upon the effective date of this act, for those eight water segments within Lake Okeechobee proper as submitted to the United States Environmental Protection Agency pursuant to s. 403.067(2).

(9) APPLICATION.—The provisions of this section are intended to supplement existing law and nothing in this section shall be construed as altering any applicable state water quality standards or as restricting the authority otherwise granted to the department or a water management district under this chapter or chapter 373. The exclusive means of state implementation of section ss. 303(d) of the Clean Water Act. Pub. L. No. 92-500, 33 U.S.C. ss. 1251 et seq. shall be in accordance with the identification, assessment, calculation and allocation, and implementation provisions of s. 403.067.

(10) CONSTRUCTION.—Nothing in this section shall be construed as limiting the applicability or consideration of any mixing zone, variance, exemption, site specific alternative criteria, or other moderating provision.

(11) IMPLEMENTATION OF ADDITIONAL PROGRAMS.—The department shall not implement, without prior legislative approval, any additional regulatory authority pursuant to the Clean Water Act ss. 303(d) or 40 CFR Part 130, if such implementation would result in water quality discharge regulation of activities not currently subject to regulation.

(12) In order to provide adequate due process while ensuring timely development of total maximum daily loads, proposed rules and orders authorized by this act shall be ineffective pending resolution of a section 120.54(3), 120.56, 120.569, or 120.57 administrative proceeding. However, the department may go forward prior to resolution of such administrative proceedings with subsequent agency actions authorized by s. 403.067(2) through s. 403.067(6), provided that the department can support and substantiate those actions using the underlying bases for the rules or orders without the benefit of any legal presumption favoring, or in deference to, the challenged rules or orders.

Section 4. Subsection (1) of section 403.805, Florida Statutes, is amended to read:

403.805 Secretary; powers and duties.—

(1) The secretary shall have the powers and duties of heads of departments set forth in chapter 20, including the authority to adopt rules pursuant to ss. 120.536(1) and 120.54 to implement the provisions of chapters 253,

9

CODING: Words ~~stricken~~ are deletions; words underlined are additions.

373, and 376 and this chapter. The secretary shall have rulemaking responsibility under chapter 120, but shall submit any proposed rule containing standards to the Environmental Regulation Commission for approval, modification, or disapproval pursuant to s. 403.804, except for total maximum daily load calculations and allocations developed pursuant to s. 403.067(6). The secretary shall have responsibility for final agency action regarding total maximum daily load calculations and allocations developed pursuant to s. 403.067(6). The secretary shall employ legal counsel to represent the department in matters affecting the department. Except for appeals on permits specifically assigned by this act to the Governor and Cabinet, and unless otherwise prohibited by law, the secretary may delegate the authority assigned to the department by this act to the assistant secretary, division directors, and district and branch office managers and to the water management districts.

Section 5. The department, coordinating with the water management districts and the Department of Agriculture and Consumer Services, shall evaluate the effectiveness of the implementation of total maximum daily loads for a period of 5 years from the effective date of this act. The department shall document that effectiveness, using all data and information at its disposal, in a report to the Governor, the President of the Senate, and the Speaker of the House of Representatives by January 1, 2005. The report shall provide specific recommendations for statutory changes necessary to implement total maximum daily loads more effectively, including the development or expansion of pollution prevention and pollutant trading opportunities, and best management practices. The report shall also provide recommendations for statutory changes relating to pollutant sources which are not subject to permitting under chapter 403, Florida Statutes, or chapter 373, Florida Statutes, and which do not implement the nonregulatory practices or other measures outlined in the basin plan prepared under s. 403.067, Florida Statutes, in accordance with the schedule of the plan, or fail to implement them as designed.

Section 6. This act shall take effect upon becoming a law.

Approved by the Governor May 26, 1999.

Filed in Office Secretary of State May 26, 1999.

## **APPENDIX C**

### **HABITAT ALTERATION AND DIRECT PHYSICAL IMPACT PROBABILITY AND SOIL EROSION CALCULATIONS**



**HABITAT ALTERATION PROBABILITY**

The gopher tortoise burrow impact probability calculations are as follows:

*BDU-33 Burrow Impact Probability*Single Bomb Burrow Entrance Impact Probability:

1 BDU-33 striking PBCA  $\times$  5.8 burrows  $\times$  1 square foot  $\div$  3,141,600 potential impact areas = **0.0002% probability of 1 bomb hitting a burrow entrance**

1,359 BDU-33s striking PBCA  $\times$  0.000002 = **0.3% probability of hitting a burrow entrance from the delivery of 1,359 bombs**

1 BDU-33 striking non-PBCA test area footprint  $\times$  20.6 burrows  $\times$  1 square feet  $\div$  11,185,000 potential impact areas = **0.0002% probability of a bomb hitting a burrow entrance**

151 BDU-33s striking non-PBCA test area footprint  $\times$  0.000002 = **0.03% probability of hitting a burrow entrance from the delivery of 151 bombs**

*BDU-50 Burrow Impact Probability*Single Bomb Burrow Entrance Impact Probability:

1 BDU-50 striking PBCA  $\times$  5.8 burrows  $\times$  5 square foot  $\div$  3,141,600 potential impact areas = **0.0009% probability of a bomb hitting a burrow entrance**

303 BDU-50s striking PBCA impact area  $\times$  0.000009 = **0.3% probability of hitting a burrow entrance from the delivery of 303 bombs**

1 BDU-50 striking non-PBCA test area footprint  $\times$  81.5 burrows  $\times$  5 square foot  $\div$  44,386,000 potential test area impact areas = **0.0009% probability of a bomb hitting a burrow entrance**

34 BDU-50 striking non-PBC test area footprint  $\times$  0.000009 = **0.03% probability of hitting a burrow entrance from the delivery of 34 bombs**

Single Bomb Subsurface Burrow PBCA Impact Probability:

1 BDU-50 penetrating PBCA  $\times$  5.8 burrows  $\times$  20 square feet  $\div$  3,141,600 potential impact areas = **0.004% probability of a bomb hitting a subsurface portion of a burrow**

113 BDU-50s penetrating the PBCA  $\times$  0.00004 = **0.5% probability of hitting a subsurface portion of a burrow from the delivery of 113 bombs**

**DIRECT PHYSICAL IMPACT (DPI) PROBABILITY**

The DPI probability calculations for gopher tortoise, commensal burrow species, and tortoise nest egg clutches receptor takes are as follows:

*BDU-33*

1,359 BDU-33s striking PBCA  $\times 0.000002 = 0.3\%$  probability of a take from one of the three receptor groups from the delivery of 1,359 bombs

*BDU-50*

303 BDU-50s striking PBCA impact area  $\times 0.000002 = 0.1\%$  probability of a take from one of the three receptor groups from the delivery of 303 bombs

76 BDU-50s striking PBCA impact area  $\times 3$  skips per bomb within PBCA  $\times 0.000002 = 0.1\%$  probability of a take from one of the three receptor groups from the delivery of 76 bombs that skip three times before coming to rest.

The 20-mm gunnery DPI probability calculations for gopher tortoise and commensal species and tortoise nest egg clutches are as follows:

One 20-mm projectile striking PPCA  $\times 11.7$  tortoises  $\times 0.5$  square feet  $\div 6,354,000$  potential impact sites = **0.00009% probability of a 20-mm projectile resulting in a take from one of the three receptor groups**

12,358 20-mm projectile striking PPCA  $\times 0.0000009 = 1.1\%$  probability of a take from one of the three receptor groups from the firing of 12,358 rounds of 20-mm ammunition

The 35-mm M190 missile DPI probability calculations for gopher tortoise, commensal burrow species, and tortoise nest egg clutches are as follows:

One 35-mm M190 projectile striking PPCA  $\times 1.2$  tortoises  $\times 0.5$  square feet  $\div 656,000 = 0.00009\%$  probability of a missile resulting in a take from one of the three receptor groups

1,802 35-mm missiles striking PPCA  $\times 0.0000009 = 0.2\%$  probability of a take from one of the three receptor groups from the firing of 1,802 35-mm M190 missiles

**ESTIMATED SOIL EROSION RATES**

*The Modified Soil Loss Equation used to calculate estimated soil loss for Erosion Impact Areas 1 through 4 is as follows:*

$$A = R K L S VM$$

**Rainfall Factor**

$$R = \frac{EI}{100}$$

$$E = 916 + 331 \log_{10} i$$

**Soil Erodibility Factor**

$$K = (2.1 \times 10^{-6}) (12 - 0m) (M^{1.14}) + 0.0325(S-2) + 0.025(P-3)$$

**Slope Length Factor**

$$L = (\lambda / 72.6)^m$$

**Slope Gradient Factor**

$$S = \frac{(0.43 + 0.30s + 0.043s^2)}{6.613}$$

**Topographic Factor**

$$LS = \left( \frac{\lambda}{72.6} \right)^m \left( \frac{0.43 + 0.30s + 0.043s^2}{6.613} \right) \left( \frac{10,000}{10,000 + s^2} \right)$$

**Vegetation Factor (Seasonal change variations)**

$$VM = \frac{(VM_g M_g + VM_d M_d)}{M_g + M_d}$$

Specific limitations of the MSLE are:

- The model is empirical and may have a tendency to estimate erosion values too great when erosion rates are measured low and too low when measured rates are greater.
- The model only estimates soil loss and does not account for the probability of soil loss occurring.
- The model predicts soil loss on an average annual basis.
- The model does not quantify the material from gully erosion and soil mass movement.
- The combined LS factor has a low level of sensitivity to potential errors in the estimation of slope length and gradient.

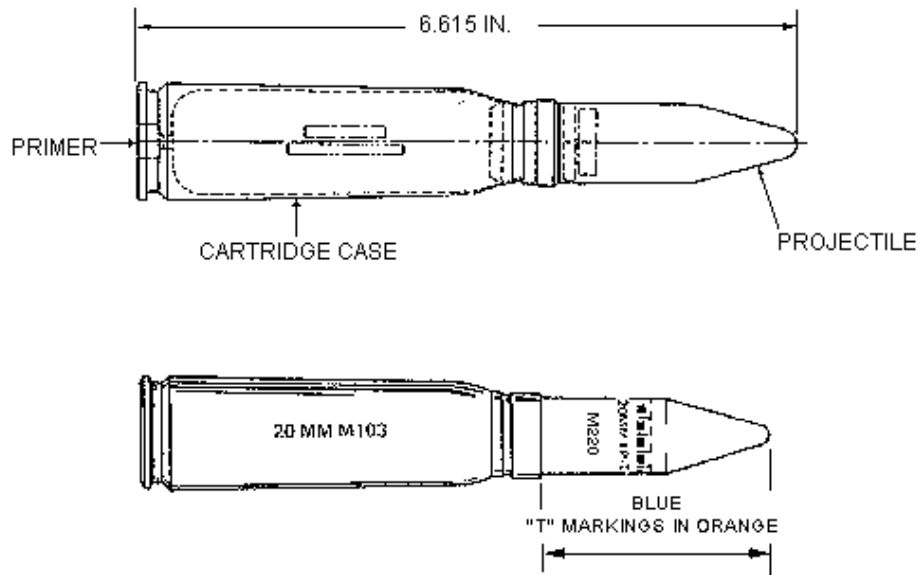
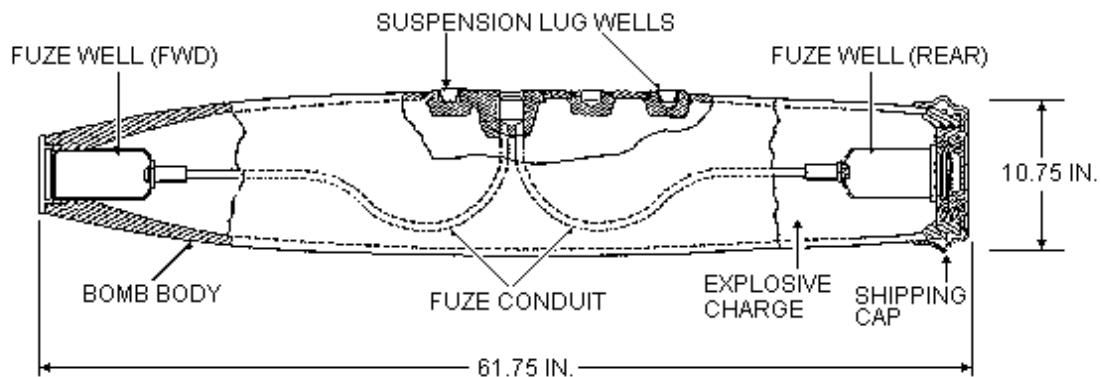
## **APPENDIX D**

### **BOMB EXPENDITURE CHARACTERIZATION**

Table D-1. Characterization of TA C-62 Bomb, Missile, and Gun Expenditures

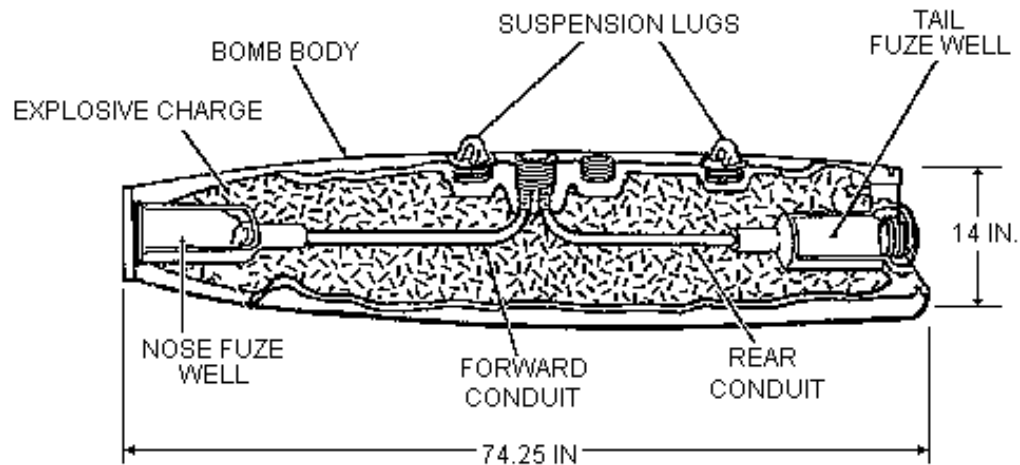
Effector	Purpose	Description	Specifications	Deployment	Composition	Footprint (feet)
<b>Bombs</b>						
BDU-33D/B Inert	Practice bombing No warhead	Unpowered and unguided bomb; spotting charge makes a mark on impact so that impact positions can be precisely tracked and evaluated.	Length: 22.9" Diameter: 4" Weight: 25 lbs.	A-10, B-1, F-4, F-15, F-16, or F-111.	Spotting charge Cast steel walls Concrete filled	N/A
BDU-50 Inert	Practice bombing No warhead	Unpowered and unguided bomb; spotting charge makes a mark on impact so that impact positions can be precisely tracked and evaluated.	Length: 66.15" Diameter: 10.75" Weight: 514 lbs.	A-10, B-1, F-4, F-15, F-16, or F-111.	Spotting charge Cast steel walls Concrete filled	N/A
BLU-109 Inert	Practice bombing No warhead					
GBU-10 Live or Inert	Hard fixed target bombing	Unpowered, laser guided, short-range bomb; system allows for stand-off capability while providing precision weapon delivery against a wide spectrum of targets; warheads: BLU-109 or MK 84 bomb and FMU-81 fuze.	Length: 172" Diameter: 15/18" Weight: 2,562 lbs.	A-10A, F-4G, F-15E, F-16A-D, F-111D-F, F-117A, or B-52H.	Cast steel walls BLU-109: 535 lbs. of tritonol, MK-84: 945 lbs. of tritonol	BLU-109: Horizontal: 2,953.5 Vertical: 2,462.7 MK-84: Horizontal: 2,468.7 Vertical: 2,099
MK-82 Live or Inert	Deep cratering, High fragmentation	General purpose, blast fragmentation, unguided, unpowered bomb used against fixed targets.	Length: 66" Diameter: 10.75" Weight: 531 lbs.	A10A, B-1B, B-52H, F-4G, F-15A-E, F-16A-D, F-111D-F, or F-117A	Cast steel walls 192 lbs. of tritonol, monol, or H-6	Horizontal: 2,059.4 Vertical: 1,738.2
MK-83 Live or Inert	Deep cratering, High fragmentation	General purpose, blast fragmentation, unguided, unpowered bomb used against fixed targets.	Length: 115" Diameter: 14" Weight: 985 lbs.	A-10A, F-4G, F-15E, F-16A-D, or F-111 D-F	Cast steel walls 445 lbs. of tritonol, H-6, or PBXN-109	Horizontal: 2,316 Vertical: 1,990
MK-84 Live or Inert	Deep cratering, High fragmentation	General purpose, blast fragmentation, unguided, unpowered bomb used against fixed targets.	Length: 129" Diameter: 18" Weight: 1,972 lbs.	A-10A, B-52H, F-4G, F-15A-E, F-16A-D, F- 111D-F, or F-117A	Cast steel walls 945 lbs. Tritonal or H-6	Horizontal: 2,468.7 Vertical: 2,099

Source: U.S. Air Force, 1996a

**CARTRIDGE, 20MM, TARGET PRACTICE-TRACER, M220****BOMB GP 500LB MK82 MOD1**

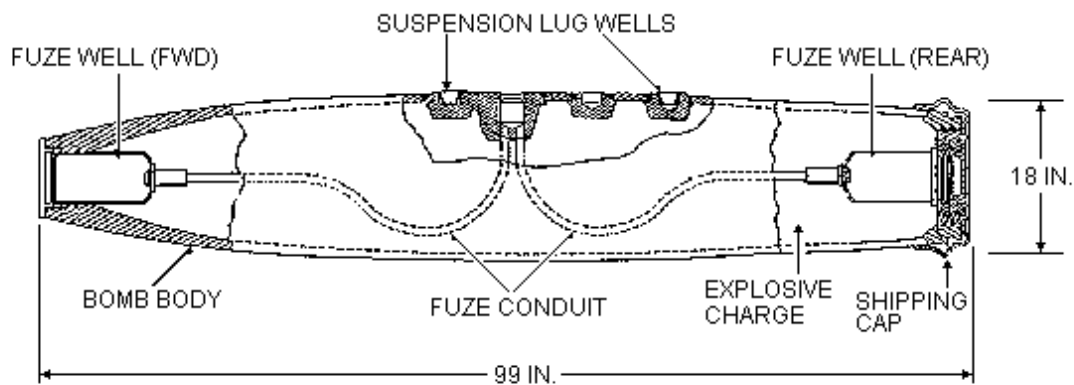
(NOTE: PRESENCE OF SUSPENSION LUGS DETERMINED BY NSN)

## BOMB GP 1000LB MK 83 MOD 4



(NOTE: PRESENCE OF SUSPENSION LUGS DETERMINED BY NSN)

## BOMB GP 2000LB MK84 MOD2



(NOTE: PRESENCE OF SUSPENSION LUGS DETERMINED BY NSN)

## **APPENDIX E**

### **TEST AREA C-62 WETLAND BOTANICAL SURVEY**



## TEST AREA C-62 WETLAND BOTANICAL SURVEY

**Date:** 24 August 2001

**Survey Crew:** Terri Hogan, Botanist  
Mike Rainer, Soil Scientist

### Report of Terri Hogan:

The areas surveyed included a seepage slope that drains into the upper reaches of Blount Mill Creek at the southern end of Test Area C-62 and Oakie Creek on the north-central portion of the test area. The seepage slope community is a unique and high priority natural community. It is one of Eglin's Conservation targets and ranks fourth in order of importance on our list of communities. Not only is this community of special concern, but the community into which the headwaters of Blount Mill Creek run (just south of the seepage slope site) is a Tier 1 longleaf pine uplands community. This is considered to be a very high quality area that should be given extra attention and protection as few remain throughout the range of the longleaf pine savanna community. The following is a list of plant taxa encountered during the survey for rare species on Test Area C-62, Eglin Air Force Base.

### State Listed Plant Species

*Drosera intermedia* (State Threatened)

*Sarracenia rubra* (State Threatened)

There were several species of *Xyris* at the site; one of these may be a state listed species.

### Seepage Slope Draining into Blount Mill Creek

*Aletris* sp.  
*Andropogon glomeratus* (Walt.) BSP  
*Andropogon gyrans* Ashe  
*Andropogon virginicus* L. var. *glaucus* Hack.  
*Anthaenantia rufa* (Ell.) Schult.  
*Aristida beyrichiana* Trinius & Ruprecht  
*Aristida beyrichiana* Trinius & Ruprecht  
*Bidens* sp.  
*Carex* spp.  
*Carphephorus odoratissimus* (Gmel.) Herb.  
*Ctenium aromaticum* (Walt.) Wood  
*Ctenium aromaticum* (Walt.) Wood  
*Dichanthelium acuminatum* (Sw.) Gould & Clark  
*Dichanthelium erectifolium* (Nash) Gould & Clark  
*Drosera intermedia* Hayne  
*Eriocaulon compressum* Lam.  
*Eryngium integrifolium* Walt.  
*Eryngium yuccifolium* Michx.  
*Eupatorium rotundifolium* L.  
*Fuirena breviseta* (Coville) Coville in Harper  
*Fuirena* spp.  
*Hypoxis juncea* J. E. Smith  
*Juncus marginatus* Rostk.  
*Juncus megacephalus* M. A. Curtis  
*Lachnanthes caroliniana* (Lam.) Dandy

*Liatris gracilis* Pursh  
*Liatris spicata* (L.) Willd.  
*Lophiola americana* (Pursh) Wood  
*Lycopodium alopecuroides* L.  
*Mitreola sessilifolia* (Walt.) G. Don  
*Myrica heterophylla* Raf.  
*Oxypolis rigidior* (L.) Raf.  
*Panicum rigidulum* Bosc ex Nees  
*Pluchea rosea* Godfrey  
*Polygala cruciata* L.  
*Polygala nana* (Michx.) DC.  
*Polygala ramosa* Ell.  
*Rhexia alifanus* Walt.  
*Rhexia petiolata* Walt.  
*Sarracenia flava* L.  
*Sarracenia psittacina* Michx.  
*Sarracenia rubra* Walt.  
*Scutellaria integrifolia* L.  
*Sphagnum* sp.  
*Utricularia floridana* Nash  
*Viburnum nudum* L.  
*Xyris* spp.

### Blount Mill Creek

*Acer rubrum* L.  
*Cliftonia monophylla* (Lam.) Britt. ex Sarg.  
*Cyrilla racemiflora* L.  
*Magnolia virginiana* L.  
*Sarracenia flava* L.  
*Oxypolis rigidior* (L.) Raf.  
*Juncus marginatus* Rostk.  
*Juncus megacephalus* M. A. Curtis

**Oakie Creek**

Cliftonia monophylla (Lam.) Britt. ex Sarg.  
 Cyrilla racemiflora L.  
 Juncus marginatus Rostk.  
 Ilex glabra (L.) Gray  
 Arisaema sp.  
 Eriocaulon compressum Lam.  
 Eupatorium rotundifolium L.  
 Xyris caroliniana Walt.  
 Xyris spp.  
 Utricularia floridana Nash  
 Drosera intermedia Hayne  
 Lycopodium alopecuroides L.  
 Magnolia virginiana L.  
 Polygala cruciata L.  
 Polygala nana (Michx.) DC.  
 Polygala ramosa Ell.  
 Carphophorus odoratissimus (Gmel.) Herb.  
 Carex spp.  
 Andropogon virginicus L. var. glaucus Hack.  
 Rhexia petiolata Walt.  
 Sarracenia rubra Walt.  
 Platanthera nivea (Nutt.) Luer  
 Sphagnum sp.  
 Myrica heterophylla Raf.

**ACERACEAE**

Acer rubrum L.

**APIACEAE**

Eryngium integrifolium Walt.  
 Eryngium yuccifolium Michx.  
 Oxypolis rigidior (L.) Raf.

**AQUIFOLIACEAE**

Ilex glabra (L.) Gray

**ARACEAE**

Arisaema sp.

**CAPRIFOLIACEAE**

Viburnum nudum L.

**COMPOSITAE**

Balduina uniflora Nutt.  
 Bidens sp.  
 Carphophorus odoratissimus (Gmel.) Herb.  
 Eupatorium rotundifolium L.  
 Liatris gracilis Pursh

Liatris spicata (L.) Willd.

Pluchea rosea Godfrey

**CYPERACEAE**

Carex spp.  
 Fuirena breviseta (Coville) Coville in Harper  
 Fuirena spp.

**CYRILLACEAE**

Cliftonia monophylla (Lam.) Britt. ex Sarg.  
 Cyrilla racemiflora L.

**DROSERACEAE**

Drosera intermedia Hayne

**ERIOCAULACEAE**

Eriocaulon compressum Lam.

**HAEMODORACEAE**

Lachnanthes caroliniana (Lam.) Dandy  
 Lophiola americana (Pursh) Wood

**HYPOXIDACEAE**

Hypoxis juncea J. E. Smith

**JUNCACEAE**

Juncus marginatus Rostk.  
 Juncus megacephalus M. A. Curtis

**LABIATAE**

Scutellaria integrifolia L.

**LENTIBULARIACEAE**

Utricularia floridana Nash

**LILIACEAE**

Aletris spp.

**LOGANIACEAE**

Mitreola sessilifolia (Walt.) G. Don

**LYCOPODIACEAE**

Lycopodium alopecuroides L.

**MAGNOLIACEAE**

*Magnolia virginiana* L.

**MELASTOMATACEAE**

*Rhexia alifanus* Walt.

*Rhexia petiolata* Walt.

**MYRICACEAE**

*Myrica heterophylla* Raf.

**ORCHIDACEAE**

*Platanthera nivea* (Nutt.) Luer

**PINACEAE**

*Pinus palustris* Mill.

**POACEAE**

*Andropogon glomeratus* (Walt.) BSP

*Andropogon gyrans* Ashe

*Andropogon virginicus* L. var. *glaucus* Hack.

*Anthraenantia rufa* (Ell.) Schult.

*Aristida beyrichiana* Trinius & Ruprecht

*Ctenium aromaticum* (Walt.) Wood

*Dichanthelium acuminatum* (Sw.) Gould & Clark

*Dichanthelium erectifolium* (Nash) Gould & Clark

*Panicum rigidulum* Bosc ex Nees

*Schizachyrium tenerum* Nees

**POLYGALACEAE**

*Polygala cruciata* L.

*Polygala nana* (Michx.) DC.

*Polygala ramosa* Ell.

**POLYPODIACEAE**

*Thelypteris* sp.

**RUBIACEAE**

*Cephalanthus occidentalis* L.

**SARRACENIACEAE**

*Sarracenia flava* L.

*Sarracenia psittacina* Michx.

*Sarracenia rubra* Walt.

**SELAGINELLACEAE**

*Selaginella* sp.

**XYRIDACEAE**

*Xyris caroliniana* Walt.

*Xyris* spp.

**SPAGHNACEAE**

*Sphagnum* sp.

**APPENDIX F**

**ORDNANCE METAL CASING CORROSION**

## ORDNANCE METAL CASING CORROSION

This section discusses the metal corrosion process and the environmental variables that may influence the wet corrosion of UXO ordnance metal casings in the soil. As discussed in Chapter 4 – Chemical Materials and Debris, potential TA C-62 UXO metal casings are susceptible to metal corrosion that could expose the soil environment to toxic concentrations of explosive chemicals.

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### *Metal Corrosion*

The U.S. Army Environmental Center has undertaken a project in Fiscal Year 2001 to identify and characterize the modes and rates of UXO casing perforations in U.S. military installation UXO contaminated soils. A computer model will be developed that will allow users to input metal type and thickness and soil characteristics such as pH, oxidizing/reducing factors, and soil classification to predict time-to-perforation. The model would provide DoD decision makers with a management tool for using UXO casing time-to-perforation predictions to:

- Conduct risk assessments regarding UXO fill material soil dilution and transport potentials
- Mitigate chemical material release rates by altering influencing soil characteristics that accelerate corrosion rates
- Focus cleanup resources on areas that have the greatest estimated impact potentials (U.S. Army Environmental Center, 2001)

The results of this study could provide a valuable tool for managing potential UXO contamination associated with the southern portion of TA C-62 and other areas on Eglin.

From the moment of their manufacture, the various metals and their alloys, except for gold, react with the environment and begin the corrosion process that converts them into stable compounds. Metal corrosion is a chemical or electrochemical reaction between the metal surface and a gaseous (dry) or damp (wet) environment that works towards destruction of the metallic structure of metals. It is widely recognized that metallic materials within the soil and water environments are susceptible to corrosion. Ultimately if the extent of corrosion is substantial enough, the element will fail.

Dry corrosion produces a surface layer of converted metal, whereas wet corrosion attacks the metal by electrically removing atoms from the surface of the metal. During the dry corrosion process, metal atoms and oxygen combine to produce a protective surface layer of converted metal (oxide) that does not react

with oxygen in the air or the metal. Eventually the layer of oxide grows so thick that the movement of electrons and ions that fuels the corrosion process stops. Provided the layer of oxide is thick enough and not cracked or perforated, the metal is protected from further corrosion. However the protective layer may crack and spall due to the differences in the thermal expansion coefficients between the corrosion products and the metal. The removal of oxygen prevents the creation of a protective oxide layer on the surface of the metal.

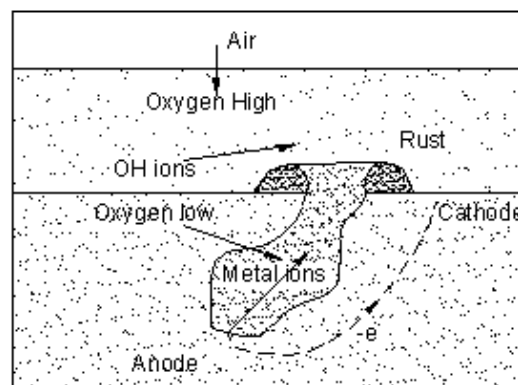
During the wet corrosion process, the corroding anode metal electrons combine with atoms of oxygen and water to make a new hydroxyl ion that reacts to make a stable compound with metal ions. Once corrosion starts, it continues until the ingredients are used up. Since electrons are able to continuously escape the parent metal, a protective oxide barrier to protect the metal surface cannot form.

Variables identified as having an influence on metal corrosion in the soil include:

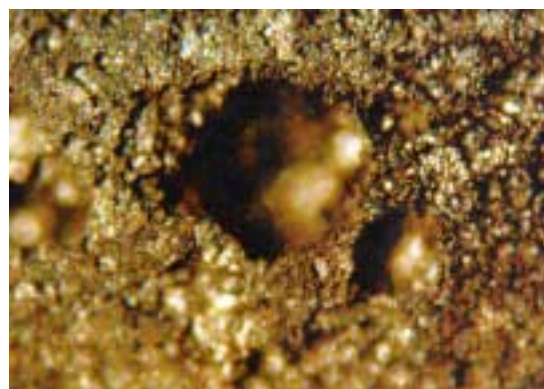
- *Water:* Water is the essential electrolyte required for electrochemical corrosion reactions. Moisture including soil moisture, rainfall, and presence of groundwater contributes to UXO corrosion.
- *Soil Texture:* Cohesive soils, those with a high percentage of clay and silt, are much less corrosive than sandy soils.
- *Degree of Aeration:* Generally oxygen concentration decreases with increasing depth of soil. In neutral or alkaline soils, the oxygen concentration has an important effect on corrosion rate due to its participation in the cathodic reaction.
- *pH:* Acidic soils represent a serious corrosion risk to metals such as steel, cast iron, and zinc coatings. Alkaline soils tend to have high sodium, potassium, magnesium and calcium contents. Magnesium and calcium tend to form calcareous deposits on buried structures with protective properties against corrosion. The pH level can affect corrosion by-products' solubility and microbiological activity.

- **Resistivity:** Soil resistivity has a strong influence on the rate of metal corrosion since ionic current flow is associated with soil corrosion reactions and high soil resistivity generally slows down corrosion reactions. Generally the higher the soil resistivity, the lower the corrosion rate with moist soils having lower resistivity than dry soils, fine soils (clay) having lower resistivity than coarse soils, and soils with high salinity having low resistivity.
- **Redox Potential:** Essentially redox (reduction-oxygenation) potential is a measure of the degree of aeration in a soil. A high redox value indicates a high oxygen level, whereas a low redox value may be an indication of low oxygen (anaerobic) conditions.
- **Chloride Level:** Chloride ions are generally harmful, as they participate directly in anodic dissolution reactions of metals and their presence tends to decrease the soil resistivity. The chloride ion concentration in the corrosive aqueous soil electrolyte will vary as soil conditions alternate between wet and dry.
- **Sulfate Level:** Compared to the corrosive effect of chloride ion levels, sulfates are generally considered to be more benign in their corrosive action towards metallic materials. The presence of sulfates does pose a major risk for metallic materials in the sense that sulfates can be converted to highly corrosive sulfides by anaerobic sulfate reducing bacteria.
- **Microorganism Influenced Corrosion:** The presence and activities of soil microbes (bacteria, fungi and other microorganisms) and their metabolites have been linked to rapid metal corrosion rates with most metallic alloys being susceptible to some form of microbiologically influenced corrosion. Microbes participate in corrosion through production of corrosive metabolic products, formation of differential aeration cells, alteration of passive films, and metabolic consumption of corrosion inhibitors. Even without oxygen (anaerobic) metal corrosion can continue due to the presence of sulfate-reducing bacteria, particularly the strains *Sporovibrio desulphuricans* and *Desulphovibrio desulphuricans*. These organisms release acidic waste products that stimulate reactions of the electrochemical corrosion process and/or strip elemental components of metals.

Types of metal corrosion include pitting, crevice, stress, bacterial, and galvanic corrosion. For metals buried in the ground, pitting is a dominant feature of the corrosion process (Figures F-1 and F-2). Uniform corrosion also exists, but in association with pitting corrosion. This becomes important considering pitting corrosion is likely to perforate a munition casing quicker than more uniform types of corrosion. Microorganisms act more as corrosion initiators than propagators; once pitting is initiated, corrosion sites are covered with corrosion and metabolic products limiting microorganism activity.



**Figure F-1. Pitting Corrosion**



**Figure F-2. Corrosion Pit on Munition Casing (160X)**

**REFERENCES**

U.S. Army Environmental Center, 2001. Personal communication SAIC with B. Packer, USAEC/Gamma Engineering. 14 November 2001.

**APPENDIX G**

**SOIL EROSION AND SEDIMENT**



## SOIL EROSION AND SEDIMENT

This section discusses the soil erosion process, describes the primary factors that influence slope erosion, and identifies principle sediment endpoints. To rehabilitate damaged sites and control soil erosion and sedimentation requires a general understanding of erosion and sediment deposition processes and principles.

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### SOIL EROSION

Soil erosion is a three-phase process of detachment, transport, and deposition of surface materials by water, wind, ice, or gravity initiated by drag, impact, or tractive forces acting on individual soil particles. It is a relentless process that is nearly impossible to stop, difficult to control, and easily accelerated by humans. Accelerated erosion caused by humans occurs at rates much greater than natural erosion conditions and has been shown to have detrimental effects on soils and ecosystems. Rainfall erosion is primarily controlled by climate, soil, topography, and vegetation. According to Wischmeir and Smith (1958), the intensity and duration of precipitation is the most important climatic factor controlling rainfall erosion.

The process of water erosion is directly linked to the behavior of water as it encounters and/or moves over the ground. During rainfall events, water that reaches the surface is stored in depressions or infiltrates into the soil. When the soil is unable to take in more water, the excess moves downslope to areas of concentrated flow, resulting in overland flow erosion. The result is on- and off-site consequences that can adversely affect the form and function of terrestrial and aquatic ecosystems. The immediate on-site net effect of erosion is loss of productivity that may alter the capability of the land to support plant and animal species and off-site problems may develop because of sediment deposition.

### Wind Erosion

Wind induced soil erosion is primarily a product of the velocity of the wind and the anchoring characteristics of soil particles (texture, topography, vegetative cover, litter, etc.). Because of the roughness of the soil surface, vegetation, and obstacles, wind speeds are generally lowest near the ground. In order for wind erosion to occur, the soil must be dry enough to be blown by the wind and periods of strong prevailing winds typically associated with large landmasses must occur. Wind erosion is a self-generating process that becomes increasingly difficult to halt as it develops. The process starts as fine soil particles become detached and strike other particles with enough force to detach

them; larger particles are exposed, making it easier for them to be detached.

Because of weather, topographic, soil texture, and vegetative cover attributes of the EMR and the overall limited spatial extent and frequency contiguous surface disturbances wind erosion is determined not to be a major contributor to soil erosion. The EMR area most prone to wind erosion is the coastal dunes along Santa Rosa Island. Wind erosion that does occur is generally limited in extent and adverse impact potentials.

### Water Erosion

Generally, soil particles undergo numerous cycles of transport and deposition that typically span single events as well as geologic time. Soil particle detachment associated with rainfall-induced erosion is initiated by raindrop impact and/or shear stress from overland water flow (Morgan, 1995; Gray and Leiser, 1982; U.S. Environmental Protection Agency, 1980). Soil erosion by water is largely dictated by mean annual rainfall. The following discussion describes water erosion associated with rainsplash and overland flow. A detailed discussion of EMR soils and soil erosion features and processes is presented in the Eglin Military Complex Environmental Baseline Study Resource Appendices, Volume 1 – Eglin Land Test and Training Range, Appendix H – Soils and Geomorphology (U.S. Air Force, 2002).

### Rainsplash

Rainsplash is a result of individual raindrops impacting exposed soil or thin layers of water covering the surface. Raindrop impacts are the most important detaching agent and cause the breakdown of soil structure and detachment of individual soil particles and aggregates (U.S. Environmental Protection Agency, 1980). It is estimated that during a heavy storm up to 100 tons per acre is splashed into the air by raindrop impacts. On level surfaces, splashed particles may move more than 2 feet vertically and 5 feet laterally. Normally, soils with a silt loam, loam, fine sand, and sandy loam textures are most prone to detachment. Coarse sands are relatively resistant to detachment because of their

weight, and clayey particles are resistant because of their adhesion and bonding to other particles (Morgan, 1995).

Soil consolidation and compaction in the top 1-inch layer of bare topsoil has been shown to increase by 15% as a result of raindrop impacts (Gray and Leiser, 1982). This type of soil consolidation is typically exhibited as a thin surface crust that reduces infiltration and increases runoff. Since surface crusting decreases with increasing contents of clay and organic matter, loams and sandy loams are most vulnerable to crust formation (Morgan, 1995).

### ***Overland Flow***

The movement of soil from one place to another requires that work be done. Overland flow erosion constitutes a form of geomorphic work that is performed whenever driving forces (impact, drag, and traction) exceed the resistance forces (surface friction) encountered (Toy and Hadley, 1987). Under conditions of absent litter layers and compacted soil, infiltration is reduced. As a result, a given volume of stormwater is able to produce a greater proportion of overland flow than would otherwise occur, giving rise to increased expenditures of energy on the soil surface (U.S. Environmental Protection Agency, 1980). The categories of overland flow includes sheet erosion, rill erosion, and gully erosion.

### ***Sheet Erosion***

Soil particle detachment by raindrop impact normally removes soil in a uniform manner over a broad area of exposed soil known as sheet erosion. The work performed by sheet erosion is a function of the depth and velocity of runoff for a given size, shape, and density of soil particles and aggregates. Sheet flow is unique in that it occurs only where the flow surface is nearly featureless and where the flow is not mechanically disrupted by raindrop impact. This type of erosion may go undetected to the untrained eye. It is important to remember that rainsplash and sheet erosion work in concert to effectively detach, entrain, and transport materials (Toy and Hadley, 1987).

### ***Rill Erosion***

Rill erosion is the removal of soil by water flows that have been disengaged from shallow overland flow and concentrated by surface irregularities and/or disturbance into small but well-defined micro-channels or rills with depth and velocity water flows greater than adjacent areas (Toy and Hadley, 1987; Gray and Leiser, 1982). Rill migration upslope

occurs by retreating rill headcuts and downslope extension is determined by the strength of the soil and shear stress of the flowing water (Morgan, 1995). Rill erosion is more serious than sheet flow because of the increased velocity of the concentrated runoff, and its considerable erosive power is responsible for the bulk of soil-eroded slopes (Gray and Leiser, 1982).

### ***Gully Erosion***

As water flows continue to concentrate at greater depths and velocities, gullies may form. The uniqueness of gullies lies in their steep sidewalls (>50%), headcuts, tier steps along their courses, and sediment deposition fans or cones that occur in the lower portions of some gully systems. In comparison to stable channels, gullies typically have greater depth and smaller width and carry larger sediment loads. Generally, gullies are not as significant as rills in terms of total contributions of eroded soil.

Gullies are almost always associated with the landscape instability of accelerated erosion and normally start because there is an increase in the amount of runoff or runoff remains the same but the capacity of waterways to carry the runoff is reduced. The formation of gullies is often associated with the removal of vegetation, especially trees (Morgan, 1995; Toy and Hadley, 1987).

The four principal stages of gully development are downward cutting, headward erosion and enlargement, healing, and stabilization (Gray and Leiser, 1982). A gully is considered stable once a stable grade of repose is achieved through the excavation and transport of soil material by the forces of concentrated water flows.

### **Factors that Influence Slope Erosion**

Land erodibility results from the interaction of land features such as slope steepness, slope length, soil permeability, soil texture and structure, vegetative cover, rainfall duration and intensity, and other characteristics. Of these, the parameters that tend to exacerbate soil erosion include loss of vegetative cover, high soil erodibility (K factor), and slope length and steepness. The independent variable that tends to have the greatest influence on soil erosion potential is the alteration and/or removal of vegetative ground cover by anthropogenic land disturbances. As ground cover decreases and slope steepness and length and soil erodibility increases, the rates of soil erosion accelerate.

Critical sites on the EMR that have experienced the abuses of sustained soil erosion represent examples of degraded landscapes that are deficient in structural, chemical, and biological constituents necessary to sustain long-term vegetative communities. Symptoms of degraded soil conditions include structural soil damage such as compaction of surface and/or subsurface soil and denuded landscapes highly susceptible to erosion. The following sections discuss the influence of slope, vegetation, soil features, and land disturbance on soil erosion processes.

### *Slopes*

Slopes are generally defined by slope angle or gradient, slope length, and slope width. Under natural undisturbed conditions slopes do not tend to exist as straight featureless gradients but exhibit variability in terms of form and configuration. The three primary types of slopes include:

- Side Slope: Slope contour lines are essentially linear.
- Nose Slope: Curved slope contour lines convex outward with two adjacent side slopes and extending to higher elevations.
- Head Slope or Hollow: Curved slope contour lines concave outward with two adjacent side slopes and extending to lower elevations.

The overall profile configuration of slopes can be determined by the spacing of the slope contours:

- Straight Slope Profile: Contours are evenly spaced along the length.
- Convex Slope Profile: Increasing distance between contours near the top or slope crest.
- Concave Slope Profile: Increasing distance between contours near base or slope toe.

Based on the geologic history, parent materials, and environmental setting in which they develop, slope profiles are configured in a manner that promotes the stability of slope materials. Soil erosion and sediment deposition are critical processes that define the condition and stability of slope materials. As an example, stream erosion at the base of a slope will tend to produce a convex slope profile, whereas sediment deposition at the base of a slope will tend to produce a concave profile. Within the slope profile there can be an infinite combination of interslope profile configurations.

Generally, changes in slope configuration are proportional to the magnitude of disequilibrium between slope form and processes driven by applied forces and slope material resistance. Under natural conditions variations in disequilibria are normally minor, whereas substantial disturbance of sites by human activities may exhibit extensive modification of the slope and the surrounding environment.

Force applied to slopes produces shear stress on slope materials. In the case of surface runoff, the energy required to exert forces is regulated by gravity and rainfall. The force generated by runoff is subject to resistance generated by the structural strength and cohesiveness of soil materials and vegetation. These collective shear strengths act to harmlessly dissipate force by transforming kinetic energy into heat friction. However if the force exceeds the shear strength resistance of the slope materials, then the deformation and transport work of erosion may occur. At one time or another this process is enacted on different portions of the slope with the frequency and magnitude of force and strength of shear stress resistance varying over time. Only soil particles that are detached from the soil mass will erode and only soil particles that can be transported by runoff will be eroded no matter how much is detached and available for transport (Toy and Hadley, 1987; Morgan, 1995).

Wischmeier and Smith (1978), originators of the Universal Soil Loss Equation, identified several basic axioms of slope erosion processes:

- Soil loss increases more rapidly than runoff as slopes steepen.
- The logarithm of runoff to percent slope is directly proportional and this relationship is unaffected by dense sod or smooth bare ground.
- As slope materials became extremely wet, the effect of slope on runoff is reduced.
- Slope angle is weighted over slope length in setting erosion potential criteria or measuring soil loss for as slope steepness increases, slope length decreases, and so its effect on erosion.

Slope length influence on soil erosion potentials tends to increase with increasing slope angle. As an example, doubling slope length from 100 to 200 feet on a 6% slope would increase potential soil loss by 29%, whereas the same slope length at 20% slope angle would increase potential soil loss by 49%.

Natural or human disturbance changes in slope configuration by means of gradient breaks and small, interslope convex and concave surfaces can have a

dramatic impact on the concentration and drainage patterns of slope runoff.

### **Ground Cover**

Ground cover is defined as the percent of vegetation on the land surface. Vegetation has two basic qualities, its structure and its functioning, that serve to protect soil against the forces of runoff. The structure of plants, particularly their root system, physically binds soil together and effectively stabilizes slopes (Zeimer, 1981). A good vegetative cover can greatly offset the effects of climate, soil, and topography on erosion. Vegetation achieves this effect by intercepting rainfall and decreasing the velocity of runoff and the cutting power of water. Vegetation also increases soil aggregation and porosity and plant transpiration dries out the soil, enabling it to absorb more water.

Dense, spatially uniform vegetative cover results in the greatest reductions on water velocity, whereas clumpy sparse vegetative cover can result in the concentration of water and increases in overall velocity between clumps (Figure G-1). Water flows separated by the clumps of vegetation create eddying and turbulence immediately downstream of the clumps, which increases the erosive energy of the water (Figure G-2).



**Figure G-1. Water flow between clumps has begun to erode exposed soil.**

The diversity of protective functions provided by forests covers and soil stability provided by tree roots generally causes erosion rates under forests to be lower than rates of other vegetative covers (Zierner, 1981). The additional cohesive strength roots provide to the soil is generally considered to range in magnitude from 1 kPa to 20 kPa. Several studies indicate that the continued stability of many steep

forested slopes is partly dependent on soil reinforcement by tree roots. Following clearcuts, the decay of tree roots and change in subsequent soil moisture regimes often predisposes some slopes to erosion.



**Figure G-2. Rill formation downstream of the site shown in Figure G-1.**

### **Soil Erodibility**

The capability of a soil to resist soil detachment and transport is defined by its soil erodibility. The susceptibility of the soil to erosion (erodibility) is primarily dependent on soil texture, structure, infiltration, permeability, and organic matter, and the ionic strength of the eroding water. Soil erodibility generally decreases with increasing clay and organic matter content, whereas uniform silts and sands tend to have high soil erodibility (Gray and Leiser, 1982).

### **Stable Soil Aggregates**

Soil texture and structure in combination with organic matter generally govern the development of stable soil aggregates that are a critical component of soil erodibility; decreases in stable soil aggregates results in increased soil erodibility (Morgan, 1995). A summary of soil texture classes is presented in Table G-1.

Soil structure refers to the fact that particles associate with other particles forming aggregates with planes of weakness between aggregates and is directly related to soil texture, bulk density, pore space, and compaction. The forces causing soil structure deterioration are related to those activities, which encourages the oxidation of organic matter, soil aggregate destruction through mechanical or chemical means, and restriction to root development through impeding layers and compaction.

**Table G-1. Soil Texture Classes**

Texture Class	Description
Sand	This textural class has block-like, spherical, large, single grained particles with sizes ranging from 2 mm to 10 mm. Sandy soils have 70% or greater sand size particles. Many of the sandy soils on Eglin AFB such as the Lakeland series, frequently have average sand contents over 90%.
Silt	This textural class is composed of minerals that make it more like sand than clay. Particle sizes range from 0.002 mm to 0.05 mm. Silt particles are highly prone to compaction and erosion.
Clay	This textural class has platy, fine particles with sizes less than 0.002 mm. A clay soil by textural class has 40% or more clay and less than 45% sand and less than 40% silt. By nature clay soils are poorly aerated and drained. All clays have high activity and a strong affinity for water, cations, and organic matter (Conklin, 1995).

Soil aggregates are groups of soil particles that bind to each other more strongly than to adjacent particles. Aggregate stability refers to the ability of soil aggregates to resist disruption by external forces such as surface runoff. Good soil structure is a desirable soil condition that depends on the presence of stable aggregates. Generally, the greater the percentage of stable aggregates, the less erodible the soil will be (Shouse et al., 1990).

A detailed discussion of soil texture, structure, and aggregate stability is presented in the Eglin Military Complex Environmental Baseline Study Resource Appendices, Volume 1 – Eglin Land Test and Training Range, Appendix H – Soils and Geomorphology (U.S. Air Force, 2002).

#### *Soil K Factor*

The soil erodibility K factor as used in the USLE is an experimentally derived quantitative value used to determine soil resistance to the forces of erosion. K factors are calculated based on soil texture, structure, organic matter, and permeability and generally indicate soil susceptibility to sheet and rill erosion. The percent of very fine sand, other sand, silt, and organic matter are key soil erodibility components. The effect of soil organic matter on soil erodibility is profound in that it substantially increases soil aggregate stability. Typically soils become more stable and less erodible where there are decreases in the silt fraction, regardless of corresponding increases in sand or clay fractions and increases in the percent organic matter.

In considering K factors it is important to note that a soil with a relatively low erodibility factor may exhibit serious erosion when it occurs on long or steep slopes and a soil with a high soil erodibility may exhibit little evidence of erosion on short, gentle slopes. This is why soil erodibility is examined independently of the effects of other factors

(Wischmeier and Smith, 1978; Morgan, 1995). Soil erodibility classes are presented in Table G-2.

**Table G-2. Soil Erodibility Classes**

Soil Erodibility Class*	K Range
Very Low	0.00 – 0.10
Low	0.10 – 0.20
Moderate	0.20 – 0.30
Moderately High	0.30 – 0.40
High	0.40 – 0.50
Very High	>0.50

Source: Manrique, 1988

\* Erodibility risk

#### **Sediment Endpoints**

Eroded soil particles moved and deposited by a watercourse are known as sediment. Sediment delivery from the site of disturbance is primarily determined by the type of disturbance, type of erosion, and mineralogy of the source area. Sediment deposition potentials are generally related to the volume and velocity of water, the character of the transported material, the relief, ground cover, and the surface characteristics of the transport path. Coarse sands are normally transported as bedload rolling along the bottom of a channel, whereas silts and clays are suspended in the water column.

The potential for sediment deposition to wetlands and streams is generally governed by the runoff energy. If the amount of sediment is less than the runoff delivery capability, then no sediment deposition occurs between the area of disturbance and wetland or aquatic receptors. As the amount of potential sediment exceeds the runoff delivery capability, sediment deposition occurs. Encounters of suspended sediments with microrelief, surface organic matter, or standing vegetation that reduce transporting water velocities may result in sediments dropping out of suspension. The dynamics of soil erosion processes create variability with regard to

sediment deposition and delivery. Land use and the characteristics of the drainage basin have a profound affect on the quantities and endpoint destination of sediment.

A study of the soil erosion and sedimentation process by Trimble (1974) in the Southern Piedmont (SP), including portions of Virginia, North and South Carolina, Georgia, and Alabama, was conducted to characterize presettlement erosion, investigate increases in erosion associated with human disturbances, and describe spatial and chronological patterns of erosion and land use. The SP is one of the most severely eroded agricultural areas in the United States. Using soil profile truncation analysis, it was estimated the study area lost 6 cubic miles of soil material or an average of 7 inches. Important correlations between land disturbance, soil loss, and sedimentation identified during the study included:

1. Soil erosion and sedimentation were minimal prior to European settlement.
2. Stream sedimentation does not necessarily correlate directly with erosion; not all eroded soil is delivered to wetlands and aquatic systems.
3. Sediment delivery ratios within a given watershed increase exponentially with land pressure. As more land is disturbed and exposed to erosion, buffer areas become less significant and a greater proportion of eroded material enters wetlands and aquatic systems.
4. Soil erosion occurring in a relatively short time is far more significant to sedimentation than the same loss extended over decades or centuries at reduced levels of land disturbance.

Even though agricultural activities significantly accelerated soil loss, it was determined that 90 percent of the sediment produced by erosion remains on the hillslopes and stream bottoms of the SP.

Introduction of sediments and the other pollutants into ecosystems at accelerated rates resulting from human activities can adversely impact terrestrial and aquatic environments, damage or destroy cultural resources, reduce recreation use and value of affected watersheds, and increase land management and operating costs. Sedimentation occurs once sediment has moved off-site and is deposited in wetland or stream systems. Primary sediment endpoints on the EMR discussed in the following sections include in situ deposition, riparian buffers, and wetlands and streams.

### In Situ Slope Deposition

Not all soil that erodes from a slope ends up being deposited in a wetland or stream. In many cases, sediments eroded from the upper and mid portions slopes encounter natural or man-made obstacles that stack up water flows and cause all or a portion of the sediment load to fall out of suspension or the sediment load exceeds the delivery capacity of the transporting water flow causing a sediment deposition event.

Deposits upslope of vegetation or other physical barriers often create sediment berms whereas sediment fans are typically created when sediment loads exceed water transport capabilities (Figures G-3 and G-4). Sediments deposited in situ (on-site) are easily resuspended and transported. Sediment berms and fans also create features that may cause water to divert which could increase its velocity and erosive force.



**Figure G-3. Sediment berm created by a cluster of woody stems.**



**Figure G-4. Sediment fan deposition**

Once suspended in the water column, sediments will continue to be subjected to transport by water flows unless water velocities are reduced or the sediments are physically removed. The texture of the suspended soil material has a direct bearing on

settling characteristics. Heavy-settling sediments, such as coarse sand, settle out during initial water velocity reductions, whereas fine silt and clay particles may remain in suspension for extended periods of time (Table G-3).

**Table G-3. Soil Particle Settling Velocities**

Particle Diameter (mm)	Order of Size	Settling Velocity (mm/sec)	Time Required to Settle 1 Foot
10.0	Gravel	1,000	0.3 Seconds
1.0		100	3.0 Seconds
0.8		83	
0.6		63	
0.5	Coarse Sand	53	
0.4		42	
0.3		32	
0.2		21	
0.15		15	38.0 Seconds
0.10		8	
0.08		6	
0.06		3.8	
0.05	Fine Sand	2.9	
0.04		2.1	
0.03		1.3	
0.02		0.62	
0.015		0.35	33.0 Minutes
0.010		0.154	
0.008		0.098	
0.006		0.065	
0.005	Silt	0.0385	
0.004		0.0247	
0.003		0.0138	
0.002		0.0062	
0.0015		0.0035	
0.0010	Bacteria	0.00154	55.0 Hours
0.0001	Clay	0.0000154	230.0 Days
0.00001	Colloidal Particles	0.000000154	63.0 Years

Source: U.S. Environmental Protection Agency, 1975

Although in situ deposition prevents the sedimentation of wetlands or streams, the deposition of soil on other terrestrial systems can bury and kill vegetation and other organisms. Frequent movement of sediments within the slope profile hampers the establishment of vegetation important to reducing soil erosion and sedimentation potentials. Environmental damage potentials may be further expounded by the introduction of materials such as organic matter and soil-bound nutrients, pesticides, metals, or other compounds to receiving ecosystems. Sedimentation directly and indirectly impacts threatened and endangered wildlife and vegetation by altering habitats to a point that may exclude its use by species of concern.

### Riparian Buffers

Riparian buffers are strips of vegetation between areas of disturbance and wetlands or aquatic systems. The increased vegetation density of buffer strips

compared to adjacent impacted areas provides corridors that function to intercept and in some cases treat runoff. Specific riparian buffer functions can include:

- Maintain aquatic food webs through provision of organic matter and insects.
- Maintain levels of predation and competition that support riparian ecosystem attributes.
- Maintain water quality, channel configuration, and stream habitats by filtering nonpoint source pollutants.
- Regulate air and water temperature regimes.
- Stabilize streambanks with vegetation root systems.
- Moderate peak channel flows and reduce flooding through water retention and storage.



The stream adjacent ecosystems maintained by riparian buffers (Figure G-5) interact directly with runoff to regulate sediment delivery to wetlands and aquatic systems. In many cases the water velocity check-dams created by riparian buffer vegetation creates broad sediment settling zones (Figure G-6). However as water is diverted, there is the potential for sediment loads to continue through riparian buffers and potential delivery directly to wetland and streams (Figure G-7).

### Wetlands and Aquatic Systems

Because of their position on the landscape, wetlands and streams tend to be collectors and manipulators of sediment inputs. The impact of additional inputs on wetlands is generally less than on terrestrial and aquatic communities because wetland plants are adapted to anaerobic conditions (Bastian and Benforado, 1988). A discussion of TA C-62 wetlands is presented in Chapter 3.



**Figure G-5. A 50 wide riparian buffer adjacent to a stream with a dense shrub layer.**



**Figure G-6. Sediment deposits upstream of riparian buffer vegetation**



**Figure G-7. Pathway of least resistance occupied by sediment laden runoff directly into a stream channel.**



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**APPENDIX H**

**PUBLIC REVIEW PROCESS**

**Publication:**DailyNews;**Date:** Monday, September 01, 2003 ;**Section:**U.S. and World News;**Page:**5

In compliance with the National Environmental Policy Act Eglin Air Force Base announces the availability of draft Environmental Assessment (EA), Programmatic Environmental Assessment (PEA) and their Finding of No Significant Impact (FONSI) for RCS 98-571, 98-572, 98-573, 00-522 00-523 and 00-731, the Demolition of Buildings at Test Area A-15, and RCS 99-149, Test Area C-62 Programmatic Environmental Assessment, Eglin Air Force Base, Florida for public review and comment.

The Proposed Action of the "Demolition of Buildings at Test Area A-15," is to demolish six structures (Bldg. 12521, 12528, 12533, 12534, 13535 and 121588), all located at Site A-15 on Santa Rosa Island. These structures were associated with the Boeing and Michigan Aeronautical Research Center (BOMARC) missile test program conducted at Test Area A-15 between 1959 and 1985. The buildings have been inactive and have deteriorated from lack of maintenance and the effects of hurricanes.

The Proposed Action of the "Test Area C-62 Programmatic Environmental Assessment is to allow the 46th TW commander to authorize the levels of activity at the site based upon estimates of increased use. The preferred alternative would include authorizing the current baseline of activity and include a number of good management practices as well as a 100% increase in all missions except for the explosive ordinance disposal operations.

Your comments on this draft EA and draft PEA are requested. Letters or other written or oral comments provided may be published in the Final documents. As required by law, comments will be addressed in the Final document and made available to the public. Any personal information provided will be used only to identify your desire to make a statement during the public comment period or to fulfill requests for copies of the final EA, PEA, or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of the final EA and PEA. However, only the names and respective comments of respondent individuals will be disclosed. Personal home addresses and phone number will not be published in the Final EA or PEA.

Copies of the draft Environmental Assessment and Finding of No Significant Impact (FONSI) may be reviewed at the Fort Walton Beach Public Library, 105 SE Miracle Strip Parkway, Fort Walton Beach. Copies of the draft Programmatic Environmental Assessment and Finding of No Significant Impact (FONSI) may be reviewed at the Fort Walton Beach Public Library, 105 SE Miracle Strip Parkway, Fort Walton Beach, the Robert L. F. Sikes Library, 1445 Commerce Drive, Crestview, FL (850) 682-4432, DeFuniak/Walton Library, 3 Circle Dr. DeFuniak Springs, FL (850) 892-3624. Copies will be available for review from Sept. 1 through Sept. 15, 2003. Comments must be received by Sept. 18, 2003.

For more information or to comment on this proposed action, contact: Mr. Mike Spails, AAC/EM-PAV, 501 De Leon St., Suite 101, Eglin AFB, Florida 32542-5133 or email: spailsm@eglin.af.mil. Tel: (850) 882-2878 ext. 333, Fax: (850) 882-3761.

PUBLIC NOTIFICATION

**MEMO**

24 October 2003

**FROM:** AAC/EM-PAV

**TO:** EMSP

**SUBJECT: PUBLIC NOTICE RCS 99-149, "Programmatic Environmental Assessment (PEA) For the Test Area C-62 Complex," Eglin AFB, Florida**

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A public notice was published in the *Northwest Florida Daily News* on Sep. 1st, 2003 to disclose completion of the Draft EA, selection of the preferred alternative, and request comments during the 15-day pre-decisional comment period.

The 15-day comment period ended on Sept. 15th, with the comments required to this office not later than Sept. 18th, 2003.

No comments were received during this period.

//SIGNED//

Mike Spaits

Public Information Specialist